NATURE

No. 3875 SATURDAY, FEB. 5, 1944 Vol. 153

CONTENTS

	Page
Relation of Relief to Reconstruction	147
Hieronymus Fabricius, 1533–1619. By Prof. F. J. Cole, F.R.S.	149
A Philosophy of Freedom. By F. Ian G. Rawlins	150
Vitamins and Hormones. By Dr. A. S. Parkes, F.R.S.	151
World Student Relief: The Work of International Student Service. By James L. Henderson	152
National Flour and Bread: Fourth Report	154
A New Form of Microfilm Reader. By Dr. E. H. J. Schuster	155
'Magnetic' Current. By James T. Kendall	157
Obituaries:	
Prof. Pieter Zeeman, For.Mem.R.S. By Sir Owen Richardson, F.R.S.	158
Mr. Edward A. Martin. By Capt. T. Dannreuther, R.N.	159
News and Views	159
Letters to the Editors:	
Statistical Mechanics of Fields and the 'Apeiron'.—Prof. Max Born, F.R.S., and H. W. Peng	164
Rate of n-fold Accidental Coincidences.—Dr. L. Jánossy	165
Comparison of the Behaviour of Rubber-like Materials under Constant Stress and Constant Strain Conditions.—Dr. G. W. Scott Blair and B. C. Veinoglou	165
Ice-Crystal Haloes.—Sidney Melmore	166
Hydrogen Content of the Sun and of Stars of Small Masses.—Prof. N. R. Sen and U. Burman	166
Collection of Pollen and Artificial Wind Pollination.—D. Lewis and L. F. La Cour	167
Leaf Lipids of Forage Grasses and Clovers.—F. B. Shorland	168
Acetate Utilization for Maintenance of Motility of Bull Spermatozoa.—Henry A. Lardy and Dr. Paul H. Phillips	168
Effect of Factors Influencing Mutability.—Dr. S. Zamenhof	169
Physico-Chemical Nature of Bacteriolysis.—W. A. Dorfman	169
Antibiotics and Competition.—Prof. E. J. Salisbury, C.B.E., F.R.S.	170
Penicillin Dressings.—L. D. Galloway and A. J. Hobson	170
Gesture Origin of Indo-European Languages. By Prof. Alexander Jóhannesson	171
British Society of Animal Production. By Alastair N. Worden	172
Plywood Adhesives and Linings	173
Locating Buried Cables Electrically	173

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London

Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone: Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

All rights reserved. Registered as a Newspaper at the General Post Office

RELATION OF RELIEF TO RECONSTRUCTION

THE importance of the agreement setting up a United Nations Relief and Rehabilitation Administration and defining its constitution and functions, which was signed by representatives of forty-four countries at Washington on November 9, is not easily overstressed. It is a milestone in the working out of joint post-war policy. It is the first piece of executive machinery to be established, and although it covers a comparatively limited field, it foreshadows a general pattern of post-war co-operation.

The agreement creates a Council representing all member Governments, including "national authorities" like the French, which will lay down general policies and constitute standing committees, including one on supplies, one for Europe, and another for the Far East. Of this Council Mr. Dean Acheson has been elected permanent chairman. Mr. Herbert Lehman, former governor of New York, has been appointed director-general of the United Nations Relief and Rehabilitation Administration with full power and authority to carry out the relief operations contemplated. There is a Central Committee consisting of representatives of China, the Soviet Union, Great Britain and the United States, and regional committees will be appointed by the Council as required. While the relations between the Council and this Central Committee have not yet been clearly explained, on paper the latter does not override.

The new organization is to arrange measures for the relief of war victims through the provision of food, fuel, clothing, shelter, and basic necessities generally, and medical and other essential services. Its task is thus threefold. First, the organization has to build up stores of foodstuffs and other supplies; secondly, it has to see that the available supplies are distributed equitably and efficiently as the opportunity arises; and, thirdly, it has to link relief and rehabilitation so as to encourage self-help and end the need for relief by reviving production.

The admirable series of studies recently issued by the League of Nations offers not only evidence as to the imperative need for the establishment of such an organization but also guidance and warning as to the measures to be taken. We have now an opportunity to do better than in the years following 1918 although in far worse circumstances, but only on condition that we profit by the experience so painfully gained after the last War. The stock position then was much better than it can possibly be at the end of this War: the general food shortage which threatens to face the world is far from being widely appreciated, and in addition there will probably be an acute shortage of fuel and transport. The destruction and dislocation to be overcome are on a far greater scale. It has been estimated that there will be 21,000,000 displaced people in Europe, while in Asia the numbers are even larger: evacuees in China alone have been variously put between thirty and sixty millions.

The magnitude of the task which confronts the new organization is well illustrated by a recent

report for the International Labour Office by Prof. E. M. Kulischer on "The Displacement of Population in Europe", which has just been published*. To minimize the suffering, which the report also discloses, and that which is yet to come before these victims of war can find a useful settled life in a world at peace, is at least as cogent and urgent a reason as the accelerated pace of the War to advance as much as possible our preparations to relieve the needs of the occupied countries as they are liberated. It can equally inspire that sterner and supreme effort in the prosecution of the War itself, so as to hasten the day of liberation and set the shortest possible term on the suffering involved with each day the War continues.

There could be no greater mistake than to regard the proceedings of the Conference at Atlantic City in working out the technical implications of the agreement—how much food, clothing, medical and other supplies will be needed, where they are to come from, and how they are to be allocated—as any distraction from our war effort. Such deliberations are a practical test of our fitness to win the War, of the spirit in which the nations will face the problems arising out of the War and the peace. Success can only come if political and national considerations are put firmly on one side and the supplies available made a common pool upon which the most urgent needs have the first call.

The past few months have made clear some of the difficulties that lie ahead. In place of the plentiful supplies at one time anticipated, only the most careful husbanding, especially of food, will ensure that supplies are adequate. In each country it will be necessary to control and allocate goods which are scarce, taking account of the needs of the War, of its own civilian population, and of the victims of German ruthlessness. For this reason alone the Relief Administration will require strong backing to enable it to succeed. The representatives must be men who carry weight in their own country, in order to induce their fellow-countrymen to submit to the necessary sacrifices for the common good. Every effort, too, must be made to secure the full understanding of what is involved and why such sacrifices are necessary. Firm backing will also be necessary to secure equality. Liberated countries with funds must not be allowed to secure preferential treatment over others. Countries liberated first must be prevented from scrambling for goods, to the loss of countries to be freed later.

All this implies control of imports and of shipping and much international self-denial. This cannot be expected without a carefully planned programme of education. Moreover, the Relief Administration has to continue all the work that has been done in preparing for economic rehabilitation; and the high degree of technical skill required makes it essential that it should not be starved of either staff or money. Here, as in other matters, this first concrete step in world co-operation will speedily provide a searching test of our sincerity and determination to build a better world order and to profit by past mistakes and bitter experience.

There are reasons why the United Nations Relief and Rehabilitation Administration conference somewhat overshadows the Food and Agriculture Conference at Hot Springs earlier last year. The latter was concerned with long-term post-war policies; the former is concerned with the more immediate problems that will arise, first in Europe and then in the Far East. What we have already said indicates that the new Administration may be the most important executive agency in international reconstruction. From it will proceed the first steps in international co-operation for peaceful ends. Its work is necessarily tied up with all the wider problems of agriculture, currency, commercial policy, commodity control, transport, etc., on which common action by the United Nations is planned.

It is therefore of special interest to note that the proposed organization appears to embody the functional principle advocated so ably by Dr. D. Mitrany, as well as the regional principle represented for war purposes in the Middle East Supply Council and the Anglo-American Caribbean Commission. How far this pattern may determine that of post-war international co-operation generally remains to be seen, but experience gained during the War appears to be turned to account and there is less reason to fear that, this time, machinery established to further our war effort will be scrapped without forethought. The success of this practical test of our ability to co-operate may well have a profound effect not only on co-operation in other fields but also on economic and commercial policy and post-war trade generally (see p. 159 of this issue).

A notable example of the educational work required to ensure the success of the work of the Relief and Rehabilitation Administration is provided by the symposium on post-war problems arranged last February by the American Philosophical Society*. Mr. G. S. Ford's paper, "America Enters the Scene", with its note on the need for self-education and discipline if we are to solve the problems of post-war settlement and establish an economy providing the greatest possible freedom of interchange of raw materials and the finished products of man's hands and minds, could have been delivered as pertinently to a British as to an American audience. The same might be said of F. G. Boudreau's analysis of the social and economic implications of freedom from want of food, with its reminder that adoption now of adequate nutrition policies by the Governments of the United Nations would provide an expanding market for agricultural products for years to come, and that a sound nutrition policy would increase the international exchange in foodstuffs rather than diminish it." Evidence of the attitude of the smaller nations is afforded by Alexander Loudon's paper discussing the control of German industry, Halvadan Koht's paper on "The Small Nations in the Post-War World" and Oscar Halecki's paper on the problem of self-determinism, with their emphasis on democracy and on regionalism.

* "The Displacement of Population in Europe". By Prof. E. M. Kulischer. (London: P. S. King and Staples, 1943.) 6s. net.

* *Proc. Amer. Phil. Soc.*, **87**, No. 2 (August 16, 1943).

These papers, like Alexander Loveday's paper on "The Economics of Transition", show well the issues involved, and the imperative necessity of international co-operation in the formulation and execution of policies for maintaining full employment. Nor can men of science be blind to the dangers to health and the maintenance of order if we fail to provide the organization to deal with relief and rehabilitation. As the report of the International Labour Office says: "Unless there is an organisation to provide these people with means of subsistence and to give them confidence that they have not been forgotten, the highways of Europe will be blocked by long processions of destitute exiles enduring every kind of privation in an effort to return unaided to their homes".

Here is a task demanding not merely technical knowledge and first-class administration, the training of staff and the mapping out of the field; but also something akin to an international employment service and the steady co-operation of all the United Nations. On its discharge may well depend the future of European civilization and the rebuilding of the broken centres of learning and research throughout the occupied countries.

HIERONYMUS FABRICIUS, 1533–1619

The Embryological Treatises of Hieronymus Fabricius of Aquapendente

The Formation of the Egg and of the Chick (De Formatione Ovi et Pulli), the Formed Fetus (De Formato Foetu). A facsimile edition, with an Introduction, a Translation, and a Commentary, by Prof. Howard B. Adelmann. Pp. xxiii+883. (Ithaca, N.Y.: Cornell University Press. London: Oxford University Press, 1942.) 12 dollars.

THIS learned and imposing monograph will in the course of time take its place alongside Dobell's "Leeuwenhoek" as one of the classics of the critical and historical literature of biology. We already owe to Prof. Adelmann an important study of the embryological work of Coiter, and he now deals with the similar researches of the famous Padua anatomist. It is to be hoped that in the near future he will complete the trilogy by extending his historical studies to Malpighi, who, as an observer at any rate, is by far the greatest of these three heroic figures. It is true that Malpighi had the assistance of optical equipment not available to the other two, and although he frequently complained of its defects, he was nevertheless enabled to follow out the development of the heart and aortic arches in the chick with a success truly astonishing, and even unparalleled for more than a century after his time.

The plan of Adelmann's work includes the following chapters: life of Fabricius; sketch of the history of embryology before Fabricius, illustrative of the relevant biological and philosophical environment of the story (necessary in assessing the value of Fabricius's own contributions and the interpretation to be put upon them); analysis of the two embryological works on the chick and the mammal, together with a bibliographical note; translations of these two works, including ten leaves of explanatory matter accompanying a set of coloured plates in the library of the College of Physicians of Philadelphia (particularly important to most readers to whom the printed works only of Fabricius are available); facsimiles of the first editions of the printed versions; notes and commentary; literature consulted. There is also an excellent index. The one defect, or rather inconvenience, of this arrangement is the separation of the notes from the text. There are some 1,400 notes, which are not numbered consecutively but in thirty-two series, so that, for example, there are thirty-two notes bearing the number 1, and so on. Searching for the notes, which are much too important to be ignored, takes not a little time, the reader being continually switched over from one part of the work to another, and then back again, with the result that the continuity of the narrative is broken and its thread lost. Even if the harassed reader decides to read the notes separately, the drawbacks are scarcely less formidable.

A fascinating chapter of Adelmann's book is the vivid picture he draws of life in one of the most famous medical schools of Western Europe in the sixteenth century. From it we learn much of Fabricius as a teacher, of his evasions and irregularities, but we hear also of his successes, when he chose to exert himself. We owe to Fabricius, indeed, the earliest and most interesting anatomy theatre extant, now preserved as a national monument, which has been admirably described by Franklin. In this famous room, says Albinus, Fabricius was the first to dissect a human body before a great concourse of spectators. The students themselves were by no means a static factor in the situation. They exercised weighty authority in arranging courses of anatomy with their reluctant professor, nor did they hesitate to comment freely and openly on the result, whether satisfactory or otherwise.

Fabricius himself was more interested in research than in teaching. He was one of the first to emphasize the importance of the comparative approach to anatomical knowledge. His failures were due very largely to the influence of the scholastics, whom he could never bring himself completely to abandon. Nor must we forget that the vision of the pioneer cannot in the nature of things embrace the complete picture, no matter whether he is working in the sixteenth century or the twentieth. His mind is so obsessed with certain of the more obvious and attractive features of the problem under investigation that he neglects others of much greater significance. Not that he is necessarily unconscious of them, but that he fails to recognize their claim on his attention. Fabricius's own scheme of research was admirable, but in carrying it out he allowed Aristotle and Galen to play too large a part in it. If, however, the work of Fabricius is lacking in philosophical interest, it exercised an undoubted influence on the future of anatomical science, and especially on its comparative aspects. The "Fabrica" of Vesalius placed so heavy a premium on human anatomy that animal structure was in danger of neglect. It was left to Coiter, Fabricius and Casserius to restore the balance, not only by their own researches, but also by diverting the labours of others into the more profitable channel.

One anomalous and almost inscrutable feature in Fabricius's writings is that whereas he quotes liberally from his classical authorities, he often completely ignores the work of his contemporaries, even sometimes when it was carried out in his own department, and therefore must have been well known to him. For example, he claims to have seen the tensor tympani muscle in 1599, but Eustachius had

described and figured it in 1563, and the account of it published by Casserius in 1601 was contemporaneous with his own work, and the product of the school of anatomy in Padua. Again, Fabricius went badly astray on the structure of the auditory labyrinth, although the three osseous canals had been described by Fallopius in 1561, and his own pupil Casserius had discovered the membranous labyrinth of the pike in 1600. Such was the tangled mentality of the man which Prof. Adelmann has attempted, with conspicuous success, to unravel.

Fabricius's embryological researches were carried out on man, certain mammals (mostly ruminants), the grass snake, dogfish and the chick. In the chick he discovered the organ now known as the bursa Fabricii, and there are certain observations of value, but the plates are superficial and the general conclusions do not display much searching of the mind. In the mammal, however, he is much more successful, and this elaborate memoir must rank as the first treatise on *comparative* embryology. He was the first to figure and describe *accurately in detail* the cotyledonary placenta of ruminants, the peculiar bifid allantois of the sheep, the foramen ovale and the ductus arteriosus. Prof. Adelmann gives us a meticulously accurate English translation of these two memoirs, and the rendering of the many difficult passages shows that he is unwilling either to admit defeat or to hazard the long shot. We are also grateful to him for the facsimile reproductions, which for the purposes of work are as good as the originals, themselves difficult to obtain and then only at high prices. Prof. Adelmann's analytical commentary is a combination of fine scholarship, sound judgment, and a deep knowledge of the relevant modern research in the subject. It is only when all these conditions are satisfied that so important a book can be produced.

F. J. COLE.

A PHILOSOPHY OF FREEDOM

Religion, Science and Society in the Modern World
By A. D. Lindsay. (The Terry Lectures delivered at Yale University, 1943.) Pp. 64. (London: Oxford University Press, 1943.) 3s. 6d. net.

THE Terry Lectures at Yale in 1943 have been used not merely to discuss "Religion in the Light of Science and Philosophy", as the Foundation requires, but to do so in the midst of events affecting the Old World and the New to a degree never before experienced. It is such a setting which makes this nineteenth series perhaps more significant than any of its predecessors. Furthermore, Anglo-American relations are closer to-day than they were, and thus the choice of the Master of Balliol as lecturer was indeed a happy one. He recalls the historic connexion between his own College and the Franciscan movement, which stressed the acquisition of knowledge as an instrument of service. From this remark the main theme of these addresses can be discerned, namely, freedom in its connexion with religion, science and power. The strain of the Puritan can be picked up here and there; but the important thing is that the outlook so engendered is very far from negative, though perhaps scarcely everybody would subscribe to all the author's claims for it in the moulding of our traditional institutions. The pressure upon thought to issue in action would have delighted the late Prof. R. G. Collingwood, and may even be taken as yet another vindication of "Speculum Mentis". How easily, however, this urge may go adrift is seen from the fact that in our day a State has arisen wherein there is no place whatsoever for religion, science or philosophy. This is extremely suggestive: these blessings do not perish separately; they are submerged together.

The author notes in some detail our present-day assumption that science will go on indefinitely making discoveries, and adds very truly that in religion is first found the germ of the idea of infinite progress. What is not quite clear, however, is whether or not these two outlooks are trying to envisage the same thing. There is unquestionably a humanistic philosophy which looks forward—in brief—to 'bigger and better' everything. Conversely, nobody can seriously deny that all life on this world must ultimately become extinct, and that therefore the only valid progress is necessarily of a kind transcending purely mundane values. Certainly there is room in plenty for every kind of change and diversity in the meantime, but the massive doctrine of the degradation of energy still stands fast, keeping our eyes on the clock.

The impressive argument of these lectures is pleasantly interrupted for a moment or two here and there to let in something a little lighter. An example is the account of Hobbes becoming a sudden convert to geometry, upon meeting Euclid I, 47, for the first time. This experience happened in middle life, and apparently made him a 'mathematics fan', to continue unabated well beyond his ninetieth year. It is a pathetic little story, but nevertheless much to be wished that certain would-be enthusiasts of all ages and of all kinds would take note of it.

Returning to more serious things, Dr. Lindsay gives one of the best short descriptions of the Cartesian position as we now see it ever likely to be presented in a course of this nature, and goes on to declare "that the modern sciences for all their mathematics cannot do without perception and experiment and do not now want to do without them". Maybe; in fact very likely. But there are at least two most distinguished people, one at each of the ancient universities of Britain, who might rise up and set about this with no mean vigour, should they feel so disposed.

We are now constrained to see—in our day—an almost complete reversal of Descartes, who claimed a high degree of infallibility for science. Infallibility is admittedly not the same as all-sufficiency, but it will nevertheless be convenient to discuss here an important point which the Master of Balliol makes in his last lecture, on power and freedom. It is that one of the causes of our present distress is that students at our universities, on both sides of the Atlantic, have been encouraged to think of science as the be-all and end-all of human needs and affairs, whereas it is manifestly nothing of the sort. There are, we know, vast tracts of life's journey about which it can say nothing. As Prof. Koffka aptly says in his "Gestalt-Psychology", "Must we deny on week-days what we profess on Sundays?" In so far as the tendency exists, this urge to exaggerate the claims of science comes mainly from the smaller fry, very rarely from the great. Furthermore, it is a basic feature of any mature university system that the undergraduates go far to educate themselves rather than to be educated. Is it, therefore, not too much to ask that they show a modicum of mental independence and discernment? But a heavy responsibility rests upon authority to refrain from misleading, if ever, in fact, it is tempted to do so.

Some sixty years ago, the philosopher Dilthey approached this subject in a different way. He considered that whereas direct observation is the natural method for the physical sciences, the social group needs vital experience or a "living through" for its proper functioning. Dr. Lindsay adds that to starve ourselves of this re-creative imagination in an industrial age is to invite disaster.

Towards the end of the course comes much valuable meditation upon psychiatry and the interrelations between the healer and the healed. It is clear that this is a matter of the very greatest delicacy, far exceeding that of ordinary medical practice in curing bodily ills. The risks, obviously, are the gaining of power over the individual's life, and the twin evil of reducing people to neat preconceived psychological categories. The survival of human personality, in contradistinction to the rough-and-ready good of the race, needs constant vigilance. We have moved a long way from Arnold's Victorian view of the meaning of religion as "morality touched by emotion".

The Master of Balliol has deserved well of his audience—and now of his readers too—in unfolding before them what amounts in effect to a confession of faith. It may not be possible, or even desirable, to agree in detail with all that these lectures involve, but of their weight, charm and generosity there can be no doubt. F. IAN G. RAWLINS.

VITAMINS AND HORMONES

Vitamins and Hormones

Advances in Research and Applications. Edited by Prof. Robert S. Harris and Prof. Kenneth V. Thimann. Vol. 1. Pp. xvii+452. (New York: The Academic Press, Inc., 1943.) 6.50 dollars.

IN 1938 and 1939 the first two volumes of "Ergebnisse der Vitamin- und Hormonforschung" were published in Leipzig by the Akademische Verlagsgesellschaft M.B.H. It is not known whether further volumes were published, but none seems to have reached Great Britain. In 1943 the first volume of "Vitamins and Hormones: Advances in Research and Application" was published by the Academic Press, Inc., of New York. The format of the new publication, which is edited by Prof. R. S. Harris of the Massachusetts Institute of Technology and Prof. K. V. Thimann of Harvard, is highly reminiscent of that of the Leipzig publication. The scope and objects of the new publication also appear to be similar. This similarity is clearly not accidental, and suggests that "Vitamins and Hormones" has some kind of continuity with the German publication.

The format of "Vitamins and Hormones" leaves nothing to be desired, style, paper and print being excellent. One editorial improvement can, however, be suggested: I wish that the bibliographies, in which the references are numbered, were all in alphabetical order; in several instances the references are numbered in order of appearance in the text. The numbering of references permits of the omission of authors' names from the text, but it is good to note that for the most part this has not been done in the present volume of "Vitamins and Hormones". Admittedly, space is thereby saved, but the inclusion of authors' names adds greatly to the interest of the text and often gives the reader immediate valuable guidance as to the quality and orientation of the work in question.

Comparison of the subject-matter of the present volume with the second of the Leipzig "Ergebnisse" gives an interesting idea of the progress of the subjects in four years. In the 1939 volume there were eleven reviews, of which four were devoted to hormones or related substances. In the 1943 volume there are ten reviews, of which only two are endocrinological. The earlier reviews had a more general biological flavour; the later ones are concerned chiefly with specific physical, chemical or biological problems. The review by N. Jolliffe and R. M. Most, on "The Appraisal of Nutritional Status", is especially valuable at the present time, and the article by T. Reichstein and C. W. Shoppee, on "The Hormones of the Adrenal Cortex", makes most interesting reading in comparison with Reichstein's review covering similar ground in the 1938 volume. Another article in the present volume which attracts attention is by R. P. Hall, on "Growth Factors for Protozoa".

A hearty welcome should be given to "Vitamins and Hormones". The ever-increasing flood of original papers and the progressive specialization of knowledge is steadily adding to the value of authoritative surveys. Unfortunately, the organization of the writing and publication of reviews has largely grown up haphazard, and it may be suggested that serious attention should be given to the problem of organizing reviews in a manner appropriate to their importance. At present, such surveys fall roughly into two categories according to the breadth and depth of the subject-matter. On one hand, there is the kind which appears in the review journals and in the "Ergebnisse" and similar publications, and now in "Vitamins and Hormones". Such a review tends to present a general picture of relevant information on a small self-contained subject, perhaps emphasizing very recent work, but none the less presenting the survey in historical perspective and in due proportion. Many of these reviews are of the greatest value and, except on subjects showing very rapid growth, need be repeated on the same subject only at fairly infrequent intervals. The increase of knowledge is constantly making necessary the subdivision of subjects suitable for treatment in a review of this type. The second kind of review deals only with very recent work and can cover a wide field, but successive ones dealing with the same subject must be produced at short intervals of one, two, or three years. Many who have tried to write a review of this type will agree that it is most difficult to give a coherent, consecutive and accurate account of one or two years' work in a subject. The inevitable gaps and the absence of background make it impossible to fit the new observations into the general framework of the subject and lead to an appearance of extreme superficiality. When the subject chosen is too wide for discussion even of the very recent work, other difficulties arise. Recently I had occasion to pay considerable attention to a review of this kind. In twenty-five pages of text (about one thousand lines) there were references to nearly five hundred papers, that is, nearly one to every two lines. A review of this kind can be no more than a breathless catalogue giving, in most instances, no real indication of the results obtained, but merely hurried comments on what the author or the reviewer believes the results to show. This technique is to be regretted, since the results themselves are often of more permanent value than the interpretations currently placed on them, and are therefore the more worth emphasizing. A. S. PARKES.

WORLD STUDENT RELIEF

THE WORK OF INTERNATIONAL STUDENT SERVICE

By JAMES L. HENDERSON

British Committee, International Student Service

INTERNATIONAL STUDENT SERVICE dates from 1920, when European student relief was brought into being as an autonomous section of the World's Student Christian Federation to cope with the vast problems of student relief and rehabilitation in the university centres of Europe. In 1926, when the purely relief problem was less acute, and the need for a permanent organization on an international basis had come to be felt by many thousands of students, it was necessary to give European student relief a legal status in Swiss law. To this end International Student Service was formed, an autonomous body continuing the traditional work of student relief and cultural co-operation on a basis of entire impartiality in all matters of religion and politics, and thus encouraging the participation in the work of all men of goodwill, whatever their race, nationality or belief*.

In the period between the first and second world wars, International Student Service performed a two-fold function. It continued its various student relief activities and it also linked them to constant and searching inquiries into the real nature of a university and the place of the student in society. The problems of student self-help and co-operation were discussed at various international study conferences, and documents were collected concerning methods of selection of gifted students, student loan-funds, health services, hostel administration, and the place of foreign guest students in the national universities. It became a department of university research, which benefited from grants from the Rockefeller Foundation, and the Carnegie Endowment for Peace, published a series of studies on the trends of higher education in the various countries and inquired into the problems of academic overcrowding and unemployment in the learned professions, and academic freedom. Official recognition of the pioneer work of International Student Service in this field was given when the League's Committee on Intellectual Co-operation adopted the survey as a basis for its own work (Walter M. Kotschnig, "Unemployment in the Learned Professions", Oxford University Press, 1937).

In 1939 the coming need for renewed large-scale relief was evident. The World's Student Christian Federation and Pax Romana approached International Student Service, and an agreement was drawn up which, while leaving all three organizations in existence, founded a new organization in which they were combined. For this new organization the old name of European Student Relief was revived, and offices in Geneva were staffed by men and women who had worked for years with International Student Service, knew the various countries, and had the confidence of university people everywhere. Since the outbreak of the present War, student relief work has fallen into three main categories: student prisoners-of-war of all nationalities, student refugees and internees, and those students, particularly in Greece and Belgium, suffering from the extremes of malnutrition. So far as the much-needed relief work on the Continent is concerned, the British Committee of International Student Service works largely through its international headquarters in Geneva and is financially dependent on the support it receives from university men and women, graduate and undergraduate alike.

The past twelve months have seen a further aggravation of the university crisis in Europe, as well as in other parts of the world. Everywhere the impact of war has increasingly marked academic life, the very continuity of which is and will be threatened during the coming months.

In the occupied countries of Europe the struggle of the universities has reached its climax following the measures taken early in 1943 by the German authorities for the total mobilization of all manpower available on the Continent. These measures have not spared the students. In Belgium, in Holland, in Norway, labour service has been declared compulsory for them, those refusing to register being excluded from the university. In Holland things have gone a step further: following several incidents for which student groups were held responsible, each student was required to sign a declaration by which he pledged himself to undertake no action directed against the occupying power. Here, too, those refusing to sign were excluded from higher learning. In France, the entire younger university generation has been mobilized for work in Germany, this measure being carried out by the French Government itself. Events in Norway are too vivid and recent to need further comment.

In all these countries, which have furthermore been afflicted by hard material privations, the students have made a brave stand. Few have yielded without resistance. In many universities strikes and other manifestations have taken place, expressing the opposition against the measures which have been imposed. Hundreds of students have even preferred to abandon their universities, to hide in their own country, or even fly abroad, with all the risks entailed, rather than be engaged against their will in the war machinery.

In belligerent countries also the situation of the universities has deteriorated during recent months. Not only has the number of students been drastically reduced, following mobilization from the age of eighteen or even seventeen; not only have many courses been shortened, with the object of adapting the curriculum to the war emergency; but also the very existence of the universities, as independent institutions devoted to the search for truth, has been questioned in some official quarters. In both belligerent parties voices have been heard which expressed the wish that for the duration of the War the universities should limit their aim to providing the State with an adequate number of technicians and young scientific workers required for the conduct of the War. Fortunately, however, this attitude has not been generally accepted, and leading university people have expressed themselves against a tendency which has found an expression in the emphasis laid everywhere on courses in natural and technical sciences as against arts and law. But the fundamental trend remains, and it is certain that, while the War will progressively drain all resources and energies in the belligerent countries, it will reduce the area in which cultural life will be able to develop with the freedom required.

While the universities in belligerent, as well as in occupied, countries have lost the greatest part of the younger generation who, in normal circumstances,

* International Student Service (British Committee), 11*D* (Lower) Regent Street, London, S.W.1.

would have filled their class-rooms, the number has increased again of the students who, cut off from their Alma Mater and forced for one reason or another to interrupt the course of their higher education, have faced alone and prematurely the gruesome hardships of the world at war; student refugees, for whom the summer months of 1943 brought new agony and who in hundreds had to fly from countries where they were threatened with arrest and deportation; students under the occupation, constantly in danger and weakened by months of nervous strain; student prisoners worn out by more than three years behind barbed wire; thousands and thousands of young men and girls who, in soul and body, have desperately suffered during the past year as a consequence of the present tragedy.

This development in Europe could not be watched passively by the European Student Relief Fund without an attempt being made to expand the work to some, at least, of the areas where the need was deepest and where, up to this date, conditions have prevented the organization of student relief.

Educational help to war prisoners and individual relief to internees or refugees in countries such as Switzerland and southern France—still under Vichy rule—was no more enough. Hunger was the major problem of thousands of students in occupied countries; an attempt to help them had to be made.

The delicate questions of principle connected with this broadening of the European Student Relief Fund programme were discussed by its executive on a concrete issue when, in the spring of 1942, an appeal was received through the International Red Cross for the students in Greece. At first the members of the executive felt uncertain whether a positive reply should be given to this call. The fear was expressed that the fact of the European Student Relief Fund engaging in a food relief scheme, in an occupied country, would create difficulties for its Anglo-Saxon friends, and perhaps make it impossible for them to obtain any longer the licences required for transmitting their funds to Geneva. However, after a full discussion, the executive finally agreed that the European Student Relief Fund should be ready to take its share in relieving the material needs of the student, as well as the intellectual ones. In order to prevent this decision from creating any difficulty for the committees in Allied countries, the following lines of policy were adopted:

(*a*) For all questions concerning relief in Greece, the European Student Relief Fund would use the channel of the Joint Relief Commission of the International Red Cross, the agency recognized by all Governments for the administration of relief in occupied countries, and which can guarantee, through its delegates on the spot, the rapid and impartial distribution of the resources made available.

(*b*) For the financing of food relief projects, only funds raised in neutral countries such as Switzerland, Sweden or Portugal, would be used, the resources received from the Anglo-Saxon countries being restricted to the financing of the work among prisoners of war, and in unoccupied countries. At the same time, the Committees in England and the United States should be invited to take part in the expanded programme in so far as they would be able to obtain, through the suitable agencies, the transfer licences required.

Along these lines the European Student Relief Fund has developed, since the summer of 1942, an increasing activity among students in Greece and other countries affected by famine. In some instances, even the Committees in Anglo-Saxon countries have been able to make special contributions for these projects. Thus the decision taken was justified by events.

Adapting itself to the aggravated situation, the European Student Relief Fund pushed ahead energetically with an enlarged programme. Fighting against hunger and despair became the slogan under which Geneva faced its increased responsibility through the fourth year of the War.

The plight of the student groups with which the Fund is related in Europe has been equalled in other parts of the world. There are the students of the U.S.S.R., whose country has been invaded, whose institutions of higher learning have been destroyed (see NATURE of January 8, p. 49). Under the pressure of the invading forces, they have had to withdraw into the depths of their immense country. There, in the central provinces of the U.S.S.R., universities and schools have resumed their work. But conditions are precarious; the students have, in many cases, lost all their belongings; they are cut off from their families; they lack the primary necessities of life. Their need is great.

This development can be compared to the striking events which, since 1937, have taken place in China. Here, too, many universities which were situated in the coastal areas have been transferred to the interior, in regions scarcely touched by civilization. The Chinese Government and the university communities concerned, through the efforts of which this transfer has been rendered possible, have thus given splendid evidence of their faith in the value of higher learning as the foundation of a national culture. Through the six years of their gallant struggle, the Chinese students have been greatly encouraged by the uninterrupted help which they have received through the agency of International Student Service and the World Student Service Fund in New York. This help has been continued during recent months, and the students of China have become increasingly aware of the fact that their fight is the fight of all students in the world, united by a common creed of the value of truth, objectively searched for and passionately desired.

Thus the trend already visible last year towards the unification of relief efforts in the various parts of the world has been reinforced. It is no longer possible to draw a strict line between the activities in and outside the realm of the European Student Relief Fund competence. The continental frame set up three years ago has been broken by the reality of war. There is one single world conflict. Only a united world relief administration will be able to cope adequately with the needs arising everywhere.

World Student Relief is now formally constituted. Its work will be conducted in the same spirit as that of the European Student Relief Fund, and its administration will likewise be entrusted to International Student Service. The headquarters of World Student Relief will be in Geneva, where the main executive, on which the member organizations will be adequately represented, will meet. In Europe the work will be continued under the auspices of the European Student Relief Fund. Two affiliated Committees are in process of formation: the first, in New York, which will be competent to handle relief problems on the American continent, in the Far East, and provisionally in the U.S.S.R., with which contact is impossible from Geneva; the second, in London, with the special responsibilities of organizing relief within the British Commonwealth, and of

co-operating with the New York Committee in the conduct of the Chinese action.

This arrangement should enable the groups concerned with student work to cover efficiently all five continents, provision being made for ensuring the continued development of relief activities in case one of the regional centres should be paralysed following an unexpected turn in the War. Thus, an organization now exists which is well equipped for serving the cause of student solidarity, in the East as in the West, during and after the War.

NATIONAL FLOUR AND BREAD

FOURTH REPORT

From the Scientific Adviser's Division, Ministry of Food

THE present report is a continuation of the work described in the previous three reports[1] on flour and bread in Britain, and deals with 440 samples of breadmaking flour and 1,408 loaves received in the period May 8–December 31, 1943.

Quality of Flour

The quality of British-grown wheat used in the grist depends upon the stock position, but it is now generally high, as the following table shows. For the bulk of the year 10 per cent of diluents (mainly barley, but also rye and oats) were also added.

BREADMAKING GRISTS IN ENGLAND AND WALES

Period	Home Grown Wheat (min. proportions)	Diluents (fixed proportion)	Imported White Flour (fixed proportion)
From 1. 1.43	35–45 per cent	5 per cent	5 per cent
25. 1.43	35–45	10	5
7. 2.43	35–45	10	5
19. 4.43	40–45	10	5
14. 6.43	30–40	10	5
21. 6.43	20–30	10	5
28. 6.43	20	10	5
6. 7.43	Optional, according to supplies available	10	5
23. 8.43	Some areas 25 per cent. Others optional	10	5
30. 8.43	20–35	10	5
13. 9.43	30–40	10	5
27. 9.43	45–50	10	5
4.10.43	50	10	From 24.10.43: 7½
22.11.43	52½	7½	7½
6.12.43	55	5	From 12.12.43: 10
20.12.43	57½	2½	10

In the earlier months of the year, most of the flour used in Great Britain was enriched with calcium carbonate at the rate of 7 oz. per sack of 280 lb. (0·16 per cent), and, in fact, by August 1, *all* the mills in the country had the necessary equipment to make this addition, which is now general.

Fibre and Vitamin B_1. The following table shows the different levels over the 440 samples. A correction has been made in the fibre figures to allow for the small percentage of added Canadian G.R. flour (white flour fortified with vitamin B_1 to about the same level of National flour).

The 'national average' figures for fibre and vitamin B_1 in the period under review were 0·55 per cent and 1·0 I.U./gm., or practically identical with the figures for the previous period, October–May 8, 1943 (cf. Third Report).

Protein Content. This depends on the percentages

Fibre		Vitamin B_1	
Value (per cent)	Samples (per cent)	I.U./gm.	Samples (per cent)
0·4 and less	4·6	1·20 and more	2·3
0·4 " "	31·6	1·10 " "	10·7
0·55 " "	52·6	1·05 " "	22·0
0·6 " "	67·0	1·00 " "	49·0
0·7 " "	87·2	0·90 " "	83·5
0·8 " "	94·7	0·80 " "	98·0
0·9 " "	97·2		

of Manitoba and English wheats, for which the average protein contents are about 14·0 and 9·4 per cent respectively. The protein contents of the samples received during each of the five months August–December averaged 12·25, 12·1, 11·1, 11·1 and 11·0 respectively.

Granularity. The size of the bran particles continues to diminish, and 420 samples examined (after correcting for the added white flour) gave the following results:

Total over 5 silk (aperture 0·27 mm.)	Total over 8 silk (aperture 0·19 mm.)
1·5 per cent	5·4 per cent

Calcium Carbonate Content. One half-pound sample of flour from each mill is examined weekly to test the uniformity of the calcium carbonate additions[2,3]. The following table shows the results of these analyses for the month of November:

Calcium carbonate (oz./sack)	Corresponding capacity of mills (sacks/hour)	Percentage of total sack capacity examined
4·5 and less	238	4·4
4·6–5·5	448	8·1
5·6–6·4	1,156	20·9
6·5–7·5	2,599	47·0
7·6–8·5	745	13·5
8·6–9·5	290	5·2
9·6 and over	56	1·0

No. of samples tested = 1,310.

The calcium carbonate for the flour as a whole will be 7 oz. almost exactly; but there will be slight departures from this figure up and down the sack, depending upon the accuracy of feeding the calcium carbonate. Creta preparata is one of the most difficult products to feed because of its poor flowing properties, and the above table illustrates the range of variation due to this cause.

Quality of Bread

The following is a summary of the 1,408 loaves examined:

Quality	No. of loaves	Percentage
Good	297	21
Fair–Good	418	30
Fair	477	34
Poor	216	15

The lower general level of quality is due mainly to the high percentage of English wheat and the presence of diluent grains with grist. At the same time, it is of interest to note that all samples of flour received for analysis are also tested for baking quality under standard conditions. The 440 samples of flour gave the following results:

Quality	No. of loaves	Percentage
Good	194	44
Fair–Good	115	26
Fair	100	23
Poor	31	7

The above results show that approximately 70 per cent of the loaves baked in the laboratory were

graded good or fair–good, whereas the corresponding figure for the commercial loaves was 51 per cent. This difference is a rough measure of the lower average result obtained in commercial as against laboratory production.

The following factors should be borne in mind, however: (*a*) The commercial bread had been posted from different parts of the country before examination. (*b*) The laboratory loaves were baked under controlled conditions of water absorption, fermentation and temperature. Such conditions are not always possible in commercial practice. (*c*) Particular loaves may have characteristics to suit local tastes, for example, thick crust, which may be regarded as faults in examination.

It is clear, therefore, that considering present conditions and the nature of the grist, the quality of much commercial bread is surprisingly good.

The faults in the commercial loaves were due to a number of factors, chief of which was incorrect fermentation of the dough; but there was also evidence of wrong water absorption, poor manipulation and insufficient baking.

The work of this report was carried out at the Cereals Research Station of the Ministry of Food, St. Albans.

[1] NATURE, **149**, 460 (1942); **150**, 538 (1942); **151**, 629 (1943).
[2] Greer, E. N., Mounfield, J. D., and Pringle, W. J. S., *Analyst*, **67**, No. 800, 352 (1942).
[3] Greer, E. N., and Dawson, E. C., *Analyst*, **69**, No. 814, 14 (1944).

A NEW FORM OF MICROFILM READER

By DR. E. H. J. SCHUSTER

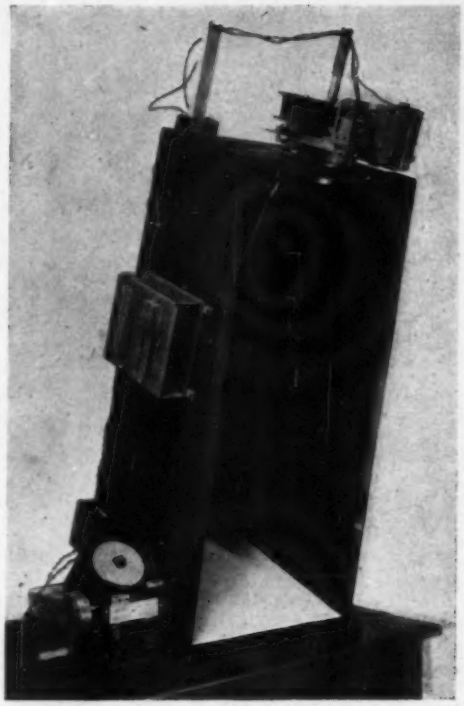


FIG. 1. MICROFILM READER AT THE NATIONAL INSTITUTE OF MEDICAL RESEARCH.

MICROFILM readers are divided primarily into two classes: in one, the magnified image of the film is projected on to a ground-glass screen from behind and is viewed as a transparency; in the other, the image is thrown downwards on to an opaque screen. The first lends itself to the construction of a neater and more compact type of apparatus, but the second was thought to show a better defined image and one more pleasant to read. It was therefore chosen for an instrument designed for the Library of the National Institute for Medical Research. This consists of an open-fronted box, of which the bottom forms a reading desk and the top supports the projector. The sides are attached to a horizontal base-board; they extend below the reading desk and are so shaped that the latter makes an angle of 20° with the horizontal, and the back slopes forward at the same angle to the vertical; the angle of slope of the front edges of the sides is slightly less.

The Projector is an independent unit consisting of a 'Bakelite' platform on the upper surface of which are mounted the following components: (1) The lamp (a Kodak miniature projection lamp, 100 volts, 100 watts) in its housing. (2) The condensing lenses. (3) The pressure plates. One of these is fixed to the lens holder and the other is held in guides which allow it a limited movement backwards and forwards. Normally it is held against the fixed plate by springs at either end, but two small electromagnets, one mounted near each spring, when energized can overcome the resistance of the springs and separate the plates, giving a free passage for the film. (4) The lens holder, which as just stated carries the fixed-pressure plate at one end; at the other is a focusing mount for the lens. The lens is of 2-in. focus and *f*/3 aperture. (5) The prism. The vertical face of this is as near as possible to the front of the lens, the oblique face is silvered and the centre of the horizontal face coincides with the axis of rotation of the projector platform. (6) The spool spindles. Mounted below the platform are its locating tube and the spool-spindle gearing. The locating tube is attached at right angles to the platform immediately below the prism; a hole is cut in the platform concentric with it. The tube is about 2¼ in. in internal diameter and 2½ in. long; it slides into a cylindrical bearing which passes at right angles through the top of the box. The whole projector can be swung about this bearing through any angle, so that a page, however situated on the film, can be viewed with its top upwards. There is enough friction to maintain the projector firmly in any position. The outer circumference of the cylindrical bearing forms a journal for a ring gear, through which motion is transmitted from the control unit to the spool gearing.

The Control Unit is attached to the left hand of the base board near the front, with its handle conveniently placed for operation by the left hand of the user. By this handle the film can be moved backwards or forwards, and it is so constructed that before the film can be moved the pressure plates must be separated.

Automatic Control of the Pressure Plates. This is effected in the following way: the handle has inner and outer concentric cylindrical portions; the former is rigidly attached to the horizontal shaft of the control unit and the latter to a rod which passes centrally through the shaft and engages with the

FIG. 2. CONTROL UNIT.

spring-loaded moving arm of an electrical key at its far end. When the handle is not in use, three equally spaced rollers with radial axes carried inside the outer handle cylinder rest at the bottom of three V-shaped grooves cut in the free edge of the inner handle cylinder. When the handle is turned, at first only the outer portion moves; the rollers ride up on one side or the other of their grooves, and this imparts a short axial movement to the outer handle, which causes the central rod to pull the moving arm of the key into contact with the fixed arm; an electric circuit is thus closed which energizes the magnets separating the pressure plates. When contact is made, further movement of the outer handle is stopped and the whole handle and the horizontal shaft turn as one piece. When the handle is no longer being turned, contact is broken by the spring, which at the same time pulls the rollers back to the bottoms of their grooves. A trickle charger supplies low-tension rectified current for the magnets.

Movement of the Film. Rotation of the handle is transmitted to the spools in the following way. On the horizontal shaft is mounted a spiral gear wheel which meshes with a similar wheel on a short vertical shaft in the control unit. A rod provided at each end with a universal joint is attached below to the vertical shaft just referred to, and, passing through a slot in the left side of the box, is attached above to another short vertical shaft. This passes through a bearing in the top of the box and carries above a spur wheel meshing with the lower edge of the ring gear; the upper edge of the latter engages with intermediate wheels, which in turn mesh with the spool-spindle gears.

The two spools may be differentiated as the fixed spool and the loose spool; the former is an integral part of the apparatus and the latter belongs to the particular film being read. The spindles carrying both pass through bushes in the projector platform and carry the spindle gears referred to above on their lower ends. The nature of the motion transmitted to the spindle gears is different in the two cases. When all gears are in mesh one revolution of the handle in either direction causes one revolution of the fixed spool in the corresponding direction, but the amount of rotation of the loose spool varies, being just that which is necessary to give off what film is being taken up by the fixed spool or to take up what is given off by it; this, of course, alters with the angle through which the fixed spool has been turned and with its diameter as affected by the amount of film wound on to it. When the fixed spool is full and the loose spool is empty, the latter will have to turn three times as fast as the former. The construction which enables the loose spool spindle to function correctly is as follows: its gearing is such that one turn of the control handle can cause three turns of the spindle, but by the interposition of a ratchet the turns will only be in the direction which will enable the loose spool to take up the film given off by the fixed spool; the giving off of film is permitted by the spindle slipping in the sleeve by which it is attached to its gearing. The correct degree of friction between the two is maintained by a spring-loaded felt washer. Slipping also occurs when the loose spool is taking up film, its degree varying with the relative amounts of film wound on the two spools.

The intermediate gears between the ring gear and the spool gears are mounted on swinging brackets; thus either spool can be thrown out of gear. It is convenient to use this device when inserting a film as it enables both spools to be turned as required by hand, and when rotating the projector. When rewinding a film on to the loose spool it saves a good deal of time and physical effort to throw the fixed spool out of gear; the loose spool then takes its time from its own gearing and a three-to-one increase of speed is obtained.

Indexing. As the films used in a library may be long enough to contain 800 pages of a book or more, it is of some importance to be able to wind straight to a point as near as possible to the page needed, without having to keep stopping the film to see where one has gone. If the tightness of winding does not vary very much, then whenever the film is used, any page on it will come into view each time after approximately the same number of degrees of rotation of the spool, or, which amounts to the same thing, of the handle. All that is required, then, is a measure of the rotation of the handle and the indexing of each film in relation to it. The first is provided by the control unit; its horizontal shaft carries a fine-pitch worm; this drives a wheel with a large number of teeth mounted on a shaft which passes through a bush in the front panel of the control unit. A dial graduated according to an arbitrary scale is mounted on the shaft where it emerges from the bush, being held friction-tight by a spring washer against a flange. Any division on the scale can thus be set by hand to a fixed reference point; but the friction is great enough to ensure that the dial will otherwise always turn with the shaft. The face of the dial is tilted upwards so as to be easily read by the user.

The index should be made when the film is first delivered to the library. The indexer turns the film to the first reference to be entered and then sets the dial to zero. Then as he works through the film he notes the dial reading at which each other reference appears. A table of contents 'paged' according to the scale on the dial thus results, from which such alphabetical indexes as may be required can be derived. Where the film is of a continuously paged book, a concordance between the dial readings and the page numbers of the book may be used in conjunction with the index of the book itself. As it would be very inconvenient to turn to the index in the film, it must be consulted from a copy, possibly abbreviated.

It may well be found convenient in libraries to store short lengths of film by sticking them together into long continuous rolls; the identification number of the roll together with the dial reading recorded

in a card index would enable any item to be found quickly.

Acknowledgments. The optical system used in the instrument described was designed by Mr. J. Smiles, of the National Institute for Medical Research, and he also selected the components. I have to thank Mrs. Moholy, director of the Microfilm Service of the Association of Special Libraries and Information Bureaux, for much valuable information and help.

'MAGNETIC' CURRENT

By JAMES T. KENDALL

Research Department, Metropolitan-Vickers Electrical Co., Ltd.

THE account of Ehrenhaft's claim to have discovered a magnetic current, which appeared in the daily Press of January 17, is very brief and possibly inexact. However, it appeared to be so completely contrary to the fundamental conceptions of electricity and magnetism, that thoughtful readers must search their minds for other interpretations of the experimental phenomena he is reported to have observed. Accordingly we at once set up apparatus to repeat the experiments which the Press had described.

The soft iron pole-pieces of a powerful electromagnet were immersed in dilute hydrochloric acid. A fine stream of bubbles was given off at each pole, and when the magnetizing current was switched on, the streams of bubbles tended to be deflected into the space between the poles, which was 1·5 mm. wide. Some of the bubbles were deflected downwards, against their buoyancy. Close observation showed that the motion of the bubbles was apparently caused by the motion of the liquid as a whole. Small inequalities of concentration, which are shown up as refractive index striations, permit any motion of the liquid to be recognized. Under the influence of the magnetic field, a steady streaming of the liquid from the pole faces into the centre of the gap and the consequent setting up of rotary currents in the liquid were observed. The streams of bubbles were entrained and carried along with this movement, and their motion was mainly controlled by it.

Confirmation of this motion of the liquid was obtained by repeating the experiment with the pole-pieces covered with a film of paraffin wax, and immersed in a solution of ferrous chloride. Under these conditions no bubbles were formed and no movement of the liquid in the magnetic field took place. However, if water was slowly poured into the solution, thus providing a non-uniform concentration of ferrous chloride, movement of the liquid in the magnetic field did occur. If the addition of water was stopped, the motion gradually died away as the concentration of ferrous chloride regained uniformity.

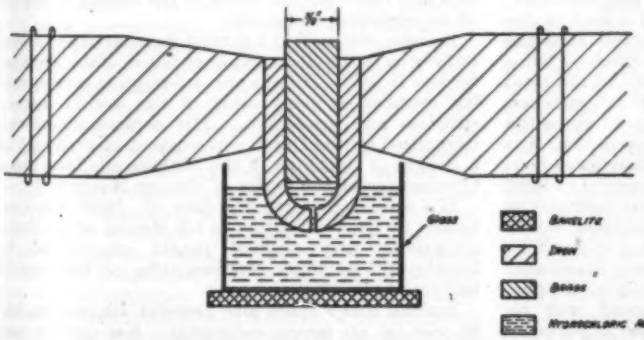
The movement of the liquid under the conditions above described can be explained very easily. It is due to the action of the strong, non-uniform magnetic field on the non-uniform concentration of paramagnetic ferrous ions. The parts of the liquid containing a high concentration of ferrous ions will tend to move into the strongest parts of the field. In confirmation of this, a number of other electrolytes were tried, both with waxed and unwaxed pole-pieces. No movement was observed with potassium chloride or cadmium sulphate under any conditions. Movement was observed with ferrous sulphate, ferric chloride and nickel sulphate under conditions of non-uniform concentration.

These experiments demonstrate conclusively that the general movement of the liquid, disclosed by refractive index striations, depends essentially on the presence of ferrous or other ions of high magnetic susceptibility. We wished to be sure that the movement of the bubbles formed at the unprotected iron pole-pieces was also due to the movement of the liquid, caused by the presence of the ferrous ions, which are provided by the solution of the pole-pieces in the acid. Accordingly the pole-pieces were heavily plated with cadmium and were then immersed in dilute hydrochloric acid. Bubbles of gas were liberated as before, but their motion in the liquid was entirely unaffected by the magnetic field: it was impossible to tell from their motion whether the magnetizing current was switched on or not.

In addition to the motion of the bubbles in the magnetic field, Ehrenhaft is also reported to have claimed that oxygen is evolved at the north pole and hydrogen at the south pole. Accordingly we immersed the bare iron pole-pieces in dilute hydrochloric acid and collected the gas from each pole separately. To facilitate this, a thin strip of mica was placed between the poles. The oxygen content of the gas was determined by heating a platinum filament to redness in it. A slight contraction in volume took place, corresponding to 0·54 and 0·49 per cent of oxygen in the gas from the north and south poles respectively. The probable error in analysis was $\pm 0{\cdot}03$ per cent of oxygen. This small percentage of oxygen was expected, since during the course of the experiment the pole-pieces became warm (due to the current in the magnetizing coils) and air dissolved in the acid would then be evolved. It would seem to be rather difficult to prevent the presence of a little oxygen (due to this cause) in the collected gas, and perhaps Ehrenhaft's reported observation may be accounted for in this way.

A third reported observation—that the pole strength of a permanent magnet decreases when immersed in dilute acid—we have not attempted to confirm. If sufficient of the permanent magnet were dissolved away, there would, of course, be a measurable decrease in its pole strength.

Our interpretation of the experiments we have made here may



EXPERIMENTAL ARRANGEMENT OF THE ELECTROMAGNET.

perhaps explain the effects attributed in the Press to Ehrenhaft. These may turn out to be no more valid than his previous claims of the existence of charges smaller than the electron (see *Phys. Z.*, 21, 675, 683; 1920). However, we must reserve final judgment until a fuller account of his experiments is available.

Apart from the failure here to confirm some of Ehrenhaft's reported effects, the observation of the movement of the liquid caused by paramagnetic ions in the magnetic field is of some interest. It may possibly form the basis of a method for separating the rare earth elements, the aqueous solutions of which differ markedly in magnetic susceptibility. The modern method of separating gaseous isotopes by thermal diffusion might be paralleled by a method of separating aqueous rare earth ions by 'magnetic diffusion'.

The accompanying diagram, drawn to scale, shows the arrangement of the magnet and soft iron pole-pieces: it should be noted that they are soldered to a brass block. This forms an important feature of the apparatus, and was provided to ensure that the experiments could not be vitiated by the passage of unsuspected leakage currents through the liquid. The average magnetic field between the pole-pieces was measured and found to be 11,000 gauss.

OBITUARIES

Prof. Pieter Zeeman, For.Mem.R.S.

PIETER ZEEMAN was born, the son of a clergyman, at Zonnemaire, Holland, on May 25, 1865. In 1885 he went to Leyden, where he became a pupil of H. A. Lorentz and Kamerlingh Onnes, and took his doctor's degree in 1893 with a thesis on measurements of Kerr's magneto-optical phenomenon. He held various positions in the physics department of the University of Leyden between 1890 and about 1900. In that year he was appointed professor of physics in the University of Amsterdam, where he spent the rest of his life.

It was while he was at Leyden, in 1896, that he discovered the effect since known by his name. In a nutshell, this is the fact, hitherto unknown, that the quality (frequency) of light is changed if the light is generated in a magnetic field. This implied an immediate connexion between two great branches of physical knowledge, light and magnetism, previously almost without contact. The mathematical expression of the fundamental effect in its simplest form is $\Delta\nu/H = \frac{1}{2}\, e/mc$, where $\Delta\nu$ is the change in frequency of the radiation, H the strength of the magnetic field, c the velocity of light *in vacuo*, and e and m the charge and mass of the emitting particle. Thus the change of frequency per unit field multiplied by twice the universal constant c is equal simply to the ratio of the charge to the mass of the emitting particles. This result, together with others of interest about the polarization and other details of the radiation, was deduced in 1897 by Lorentz as an inevitable consequence of the assumption that the emission of light was caused by the motion of electrified particles in an electro-magnetic field. While this statement would have been hotly contested in 1896, it is difficult to appreciate now that there was then any reasonable alternative short of the miraculous creation of light.

These considerations—and they could well be amplified—suffice to establish the basic importance of Zeeman's discovery; but in other respects also it was one of the most remarkable discoveries in the history of physics. Historically, it claimed immediate attention as a conspicuous success where Faraday had been baffled half a century earlier. The epoch of its origin was singularly auspicious. In 1897, measurements of e/m for the carriers of the cathode rays by the magnetic deflexion method were published by J. J. Thomson in England and by Wiechert in Germany. Their results were identical within the experimental error with the value found by Zeeman for the particles emitting spectral lines. But all these values were 1,850 times as great as the value of e/m for the lightest charged particle, the hydrogen ion, recognized by electrochemistry. If electricity was essentially atomic, a conclusion almost forced by Faraday's laws of electrolysis, we were here dealing with an apparently ubiquitous particle having a mass m much less than that of the smallest accepted particle, the hydrogen atom. This was settled soon afterwards by direct measurements of e by J. J. Thomson, confirmed by Planck's calculation from the intensity of heat radiation, which showed that their charge was indeed the same as the charge on the hydrogen ion. Thus was the electron born.

Another remarkable, and also perhaps fortunate, circumstance attending Zeeman's great discovery was that it was made at a time when the experimental technique was good enough to reveal the essential foundations, but not good enough to disclose the complicated structures which subsequent technical refinements brought out. Had the discoverer been confronted with all this at the outset, he might have despaired of ever making any sense of it. However, these developments, in which Zeeman himself played a notable part, have proved very important in several directions, and particularly helpful in clarifying and extending the quantum theory.

The Nobel Prizes, which are awarded annually, commenced in 1901. In that year the prize for physics went to Roentgen for his discovery of X-rays. In 1902 this prize was divided between Lorentz and Zeeman for researches on the influence of magnetism on the phenomena of radiation. This is another illustration of the timeliness of the discovery and of the prompt appreciation of its importance.

Zeeman's was a life devoted to increasing and improving our knowledge and understanding of physical phenomena by experimental methods. Much of it was in the field of magneto-optics, in which he was successful so early, and the greater part of it has had some optical connexion. This is not the place to review this in detail, but there is one thing that must be said. It is all characterized by extreme thoroughness and bears the hall-mark of the master of the art of experimental discovery.

Zeeman was elected a foreign member of the Royal Society in 1921 and an honorary fellow of the Physical Society in 1929. He was also a foreign or corresponding member of many other of the world's learned societies and academies. His achievements were recognized by the Dutch Government in creating him a Knight of the Order of the Netherlands Lion and a Commander of the Order of Orange Nassau.

His seventieth birthday, May 25, 1935, was celebrated by the publication in his honour of a volume comprising fifty original papers contributed by friends and admirers representative of the world's leading physicists.

Zeeman had a quiet and peaceful disposition, but he was by no means unforceful. His manner and temperament inspired immediate confidence. He was

very genial and likable, and his loss will be mourned by many sincere friends. He died on October 9, 1943, after a short illness and is buried in the Kleverlaan Cemetery at Haarlem. He was a worthy member of that company of great men who have made Holland, despite its handicap of size and population, stand out among the nations in the history of scientific achievement.

OWEN W. RICHARDSON.

Mr. Edward A. Martin

MR. E. A. MARTIN died at the age of seventy-nine on December 14 at Brighton, where his father had been mayor before him. Mr. Martin was well known as a lecturer on geological subjects, some of which he published in book form. His "Sussex Geology and other Essays" (Archer and Co., London, 1932) includes a chapter on "Clayton Windmills and the Dew-Ponds", among which is mentioned the windmill illustrated in NATURE of February 27, 1932, from the great Chinese Encyclopedia of 750 volumes in the eighteenth century. His researches on dew-ponds appeared in papers for the British Association and Royal Geographical Society. Other essays appeared in the *South-Eastern Naturalist*, of which he was honorary editor from 1916 until 1924.

Mr. Martin was honorary general secretary of the South-Eastern Union of Scientific Societies during 1924–35. To readers of NATURE he will be best remembered as the author, under the initials E. A. M., of the annual reports of Congresses of the South-Eastern Union, many of which he organized personally as well as contributing papers. He edited a bibliography of Gilbert White's writings for the Selborne Society; the geology side of *Knowledge* and the *Journal of the Commons, Open Spaces and Footpaths Society*. He was actively associated with the Croydon Public Library, and while residing in that borough, served during the War of 1914–18 as a commander of the Metropolitan Special Constabulary. On resigning the secretaryship of the South-Eastern Union he became a vice-president of the Union. He retired to Brighton in 1935.

In 1887 Mr. Martin married a daughter of H. T. Carpenter, a Common Councillor of London and then a ward in Chancery. His widow and three children survive and a nephew, Henry Martin, is editor-in-chief of the London Press Association.

T. DANNREUTHER.

WE regret to announce the following deaths:

Major H. J. L. Beadnell, formerly of the Egyptian Geological Survey, on January 2, aged sixty-nine.

Dr. F. D. Chattaway, F.R.S., fellow of Queen's College, Oxford, and formerly a distinguished chemist, on January 26, aged eighty-three.

Sir John Bretland Farmer, F.R.S., emeritus professor of botany in the Imperial College of Science and Technology, on January 26, aged seventy-eight.

Dr. C. B. Kingston, president in 1938–39 of the Institution of Mining and Metallurgy, aged seventy-six.

Dr. H. A. Mess, reader in sociology in the University of London, on January 23, aged fifty-nine.

The Rev. Sir John O'Connell, vice-president of the Statistical and Social Enquiry Society of Ireland, on December 28, aged seventy-five.

Sir Kynaston Studd, Bart., O.B.E., president and honorary chairman of the Polytechnic, London, on January 14, aged eighty-five.

Sir Thomas Ward, C.I.E., M.V.O., formerly inspector-general of irrigation in India, on January 27, aged eighty.

NEWS and VIEWS

Functional Collaboration in Colonial Territories

IN the House of Lords on January 26, Lord Listowel asked what action is being taken by the Government to prepare for the organization of security, development and welfare services throughout the British Empire on a regional basis. Lord Cranborne, Secretary of State for Dominion Affairs, replied on behalf of the Government. He said that, while contentious constitutional questions should be put aside for the time being, they must be continually borne in mind. So far as regional international machinery is concerned, the idea is still sufficiently novel to arouse suspicion. Nevertheless, our limited experience of such collaboration in commissions composed of representatives of nations with colonial possessions in the areas concerned has been encouraging. This scheme of constructing machinery to link up certain territories for purposes where common action is desirable has for some time been used in the British Empire as, for example, in the East African Governors' Conference, and regional grouping in the West African Colonies. An example of its extension on an international scale is provided by the Anglo-Caribbean Commission, the working of which has been very satisfactory. The essential point in considering such functional collaboration of neighbouring territories is the realization that it involves joint control, but not joint government. Referring particularly to the recent conference between Australia and New Zealand adumbrating a scheme for such an organization for the South Pacific, Lord Cranborne said that the Government welcomes this movement, and would also welcome the establishment of machinery of a collaborative and consultative nature in other areas in which various nations with colonial interests are concerned.

European Relief during 1919-20

THE Economic, Financial and Transit Department of the League of Nations, under the title "Europe's Overseas Needs 1919–20 and How they were Met", has issued an account of the failure to face the problem of Europe's post-war requirements of raw materials and essential manufactured goods in those years. The effects of that lack of policy were neither local nor transitory. The penury of European countries induced them to husband their resources by quantitative restrictions on exports and on imports, and the fear of their lowered standard of living induced others to refuse to accept their products. Commercial policy was driven from the very outset down the wrong road and never found another. In 1918 productive capacity in Continental Europe was at an extremely low level; in 1919 industrial production was about one half, agriculture one third, below normal. During 1919 and 1920 Continental

Europe imported about 17·5 billion dollars worth of goods from overseas, against an export of only 5 billions. Foodstuffs and finished goods formed an unusually large proportion of these imports; the imports of raw materials were relatively small. Northern and western Europe received proportionately much larger supplies than central and eastern Europe. The import surplus was met mainly from shipping services (1·8 billion dollars), emigrants' allowances (1·4 billions), expenditures in Continental Europe of the American and British armies (about 1 billion), yield on foreign securities (0·7 billion), inter-governmental loans (about 2·8 billion, of which 0·9 billion were relief loans), liquidation of security portfolios, and to the extent of roughly 2·5 billions from short-term credits.

Food was supplied by relief organizations, mainly during the first half of 1919, after which relief deliveries were on a much reduced scale. No international plan was evolved for the provision of the war areas with the other goods essential for the restoration of their economic life for nearly two years after the Armistice. The ter Meulen Plan, presented to the Brussels Conference in October 1920, for raw material credits, came too late and failed to materialize, and States were forced to acquire raw materials within the limits of their own financial capacities. The absence of provision for raw material credits was an essential factor in the process of currency depreciation, inflation and hyper-inflation. Inflation and currency depreciation in their turn caused a violent redistribution of national income and wealth, and prepared the ground for social unrest and political agitation. Action was only taken when inflation and the threat of social upheaval rendered it an unavoidable political necessity. This study gives a striking reminder of the magnitude of the disaster that resulted from the absence of any general plan, the failure of production and trade to revive, the social and political effects of inflation and the extent to which those effects were accentuated by the depression at the end of the first peace decade, and that depression accentuated by the burden of debt that Europe had assumed.

Canadian Seed Potato Eye Trade

BY means of regulations issued in 1940, the Canadian Department of Agriculture exercises a strict control over the trade in seed potato eyes in the Dominion, where the raising of potato crops from eyes rather than from whole tubers is the usual practice in remote areas to which the transport of seed tubers is difficult. Eyes for sale must be cut only from certified seed, and their weight must be such that thirty-five eyes weigh not less than 1 lb. If the eyes are to be stored they are kept first for a week at 75° F. to encourage cork formation, but subsequent storage is at lower temperatures. Eyes intended for dispatch to growers soon after being cut have the cut surface either dusted with limestone or waxed to prevent drying out. The eyes must be free from obvious fungal, bacterial and insect damage and must be shipped in specified types of cartons, and with each batch of eyes sold a copy of the directions for planting issued by the Department of Agriculture must be sent. The directions for planting indicate the desirability of planting the eyes as soon as they are received in moist soil and with adequate protection against drying out. If planted in dry soil the eyes may fail to develop. The recently described experiments at Kew suggest that some of the precautions against drying out of the eyes may be unnecessary and that the use of controlled drying to produce 'dried potato eye chips' would further reduce the weight but not the viability of the eyes and so further simplify the difficulties of transport to remote areas.

Treatment of Cancer

THE annual report for 1943 of the British Empire Cancer Campaign directed attention to recent developments in the treatment of cancer. In particular, reference was made to encouraging work on the inhibition of cancer of the mammary gland and of the liver by diets; and that it has been possible to confirm statements of workers in the United States and Canada, who claimed that the symptoms of cancer of the prostate are inhibited by the administration, in the simple form of pills given by the mouth, of diethylstilbœstrol, a synthetic substance resembling other glandular products. This is a very great advance; but we shall do well to remember that, although diethylstilbœstrol relieves the symptoms of this form of cancer and makes the patient once more a useful citizen, its effects are not yet uniformly successful and no surgeon has yet claimed to cure cancer in this way. The treatment applies, moreover, to only one form of cancer. These cautions do not minimize the greatness of the advance; they are necessary only because the public is acutely sensitive to any statements about cancer research, and insists that it must not be misled about a subject which only the expert can properly understand.

The public is right to insist upon this. It should remember, nevertheless, that cancer research is still a charity mainly dependent upon the gifts of public-spirited individuals. These benefactors, as well as the general public, have a right to be sure that the work made possible by their gifts is well co-ordinated and properly controlled, and that its results are passed on to the public through the proper channels. A recent announcement issued by the British Empire Cancer Campaign will help to reassure them about this. The Campaign intends to keep practising medical men informed about the progress of cancer research, so that the public may have, through them, the advice of the Campaign's experts about suggested cancer treatments. The Campaign also intends to do all that it can to promote investigation into methods of treatment of cancer and into theories of its causation, stipulating only that full disclosure shall be made of the nature and method of use of suggested treatment, and so on. To these conditions no reasonable man can object. They are, in essence, the conditions which any scientific worker imposes upon himself whatever the nature of his scientific work may be.

Malaria in the South-West Pacific

A NEW campaign to combat malaria in the South West Pacific is to be financed under the Colonial Development and Welfare Act, 1940, and an initial grant of £65,000 to cover three years has been made for the purpose. The Anopheles mosquito, and consequently malaria, has hitherto been unknown in the territories of Fiji, Tonga, the Cook Islands, the Loyalty Islands, New Caledonia, the Gilbert and Ellice Islands and Samoa. In the islands to the west of Fiji, on the other hand, malaria is widely distributed. In peace-time, when there was little shipping traffic between the islands and air

services were unknown, the danger of the spread of infection was small, and the routine malaria control was considered sufficient. But since the outbreak of war, the establishment of large garrisons and the increase of air and sea traffic between the islands has greatly increased the danger of introducing malaria to the 'clean' islands. It is no longer safe to rely on quarantine measures; so steps are to be taken to eliminate possible places where Anopheles might breed.

Entomological surveys are to be made near shores and ports, and reconnaissance surveys of all potential breeding grounds. Normal anti-mosquito work will be intensified and danger places will be cleared, drained and oiled where necessary. At the same time an engineer will prepare a scheme for mosquito control on a long-term basis. The financial grant will cover the cost of plant, such as transport vehicles, garages, laboratories, equipment and tools, and the salaries of an engineer, surveyors, overseers, clerks, drivers and labourers for a period of three years. The measures to be taken will also wipe out the mosquitoes, other than Anopheles, already present in Fiji, which are carriers of such diseases as dengue fever and filariasis, and which would be a serious menace if yellow fever should ever be introduced to the territory.

Dehydrated Graphite Sols

DILUTE solutions of aqueous colloidal graphite have proved of service by their ready formation of electrically conductive, lubricative and opaque films (see NATURE, 149, 298; 1942). Bernard H. Porter, 25 South Street, Houlton, Maine, states that highly concentrated dispersions of the same colloid, compressed and dehydrated, constitute effective small-parts substitutes for metal. Irreversible in character, dehydrated masses of colloidal graphite are electrically conductive, markedly resistant to high temperatures, chemically inert, gas absorbent and easily machined. The commercial form of graphite hydrosol is slowly baked in pressure moulds at 90° C. Shrinkage may be so high as 85 per cent by volume. The resistivity of dehydrated graphite baked at 105° C. without pressure is 28·21 ohm-cm.; its porosity 24·93 per cent. Bars having greater conductivity than the graphite alone are formed by embedding strands of No. 30 copper wire, or strips of 60-mesh screen, in the graphite paste before baking. Metallic dusts may be admixed for the same purpose, though not without decreasing the tensile strength of the dried solid. Machine shaping, tapping and threading may follow as desired. Guard rings, connectors, electrodes, contacts, special-purpose forms and small parts normally made of metal are applications for dehydrated graphite sols.

Teletypewriter Test Sets

DISTORTIONS in teletypewriter signals are classified in three groups: bias, characteristic distortion, and fortuitous distortion. Bias, due to asymmetry in the circuit, causes all marking impulses to be lengthened or shortened. The increase or decrease is substantially equal in all the marking impulses, and the amount of bias is the lengthening or shortening expressed as a percentage of the unit pulse. As interpreted by a teletypewriter, the lengthening or shortening is what it would be if the bias affected only the beginnings of the marking impulses. Characteristic distortion differs from bias in that the amount of the distortion may vary from impulse to impulse and is dependent on the combination of the preceding impulses. Fortuitous distortion is normally non-repetitive and is caused by random interference such as cross-fire, lightning or power induction.

A teletypewriter test set has been developed by the Teletype Corporation (U.S.A.), which transmits code impulses corresponding to teletypewriter characters and distorts their timing relative to the start pulse by segments on two concentric rings over which conducting brushes are motor-driven at a constant speed. By adjusting the outer ring with respect to the inner one and connecting the segments of the two rings either in series or parallel, signals may be produced with any desired amount of marking or spacing bias, or marking or spacing end distortion. An article by W. Y. Lang (*Bell Lab. Rec.*, 21, No. 12; August 1943) describes and illustrates the set.

Directory of Natural History Societies

A "Directory of Natural History Societies" in Great Britain and Ireland is now in course of preparation for publication by the Amateur Entomologists' Society in the near future. Its aim is to make known the existence and work of societies interested in any branch of natural history (except economic, agricultural or medical problems). The compilers wish to include as large a number of such organizations now existing in Great Britain and Ireland as can be brought to their notice, from national associations and regional unions to county, town, university or school societies. Names and addresses of as many organizations as possible, particularly of the smaller clubs and societies not affiliated to any naturalists' union, school or college organizations, and the like, are now needed, and the compilers will be glad of any help that readers can give. Postcards or letters should be addressed to Mr. W. G. Rawlings, 14 Westfield Park, Bath.

Merseyside Fauna and Flora

THERE is much that has more than a local interest in the recently issued Portfolio Vol. 2 of the Merseyside Naturalists' Association, covering mainly field work in 1942. From the botanical interest, J. D. Massey discusses in a lengthy paper the changes in the flora of the Liverpool area from 1838 to 1943, during which period fifty-nine plants have become extinct, forty-six native British species have become naturalized in the district, there have been seventy-eight naturalized alien incomers, while some 250 casuals have been recorded. The flora of this district is specially interesting from the influence of shipping introductions, of industrial slag heaps, building, drainage and pollution. Eric Hardy has a note, with photographs, of a large and well-established sycamore tree (*Acer pseudo-platanus*) growing entirely parasitically from a cleft in an alder tree (*Alnus glutinosa*) at Ince Blundell, South Lancashire. T. Edmondson has a survey of the avi-fauna of a mile-long colliery lake at Leigh with 109 birds, comprising forty residents, eleven summer visitors, fourteen passage migrants, twelve winter visitors and thirty-two occasional visitors, including such interesting species as gadwall, pintail, Bewick's swan, goosander, smew, bittern, red-necked phalarope; from the migration of waders and duck, it may be part of a route across the north of England. G. C. Miller has made some detailed and statistical studies of the nesting of the house sparrow, *Passer d. domesticus*, in which

he suggests that it is probable that three broods are reared when nesting begins early in April and only two when nesting is delayed by weather until May; the period between rearing one brood and commencing another averages ten days, making altogether 113 days or an average of four months devoted to the rearing of their young. There is confirmation of the observations of B. H. Ryves (*Brit. Birds*, August 1943), including retardation of egg-laying due to inclement weather. After the destruction of previous clutches the rapidity of egg-laying produced fresh eggs after intervals of only four or five days. An average of five young per pair is a normal seasonal increase. There are also interesting observations on the building of domed nests inside nest-boxes.

Powdery Mildew of the Rose

Horticultural beauty of the rose often depends as much on the foliage as upon the flowers. Powdery mildew caused by the fungus *Spaerotheca pannosa* is a very widespread trouble upon the leaves, particularly when roses are grown under glass. The disease can be minimized, but not controlled, by keeping temperature and humidity as low as possible for the growth of the plants. Mr. Wilbur D. McCellan has re-investigated the problem of control, chiefly by spraying methods (Cornell University Agricultural Experimental Station, Bull. 785. Ithaca, N.Y.; June 1942). Sulphur-containing sprays were found to be generally superior to those containing copper, though malachite green gave the best eradicant control. Good control without injury to foliage resulted from the use of particulate sulphur. Various wetting agents were also studied, and useful control was obtained by vaporizing sulphur at 112–115° C. A considerable reduction in the amount of mildew can be obtained by frequent syringing. The paper also includes descriptions of a method of measuring contact angles of spray drops, as a means of comparing their wetting power.

Mammalian Reproduction

The title of a recent publication (1943) of the Imperial Bureau of Animal Breeding and Genetics fully indicates its contents. It is "Gestation Periods, a Table and Bibliography", compiled by J. H. Kenneth (Pp. 23. Edinburgh and London: Oliver and Boyd, 1943. 2*s*.). It contains a very long list of mammals with their common and scientific names, followed by the time in days of their gestation periods. The average time is given and also the minimum and maximum times where available. Where different times are given by different authorities, these are cited separately and all data are followed by references to the publications from which they are taken. In domestic mammals, separate times are given for the different breeds and in some instances for crosses between them. A number of workers will be grateful for this ready access to a scattered literature. A wide range of variation is shown from the sixteen days of the golden hamster, *Mesocricetus auratus*, up to the 426 days of the okapi, *Okapi johnstoni*, and 641 days of the elephant, *Elephas indicus*.

Health of Iceland

According to the *Medical Officer* of November 13, the population of Iceland is now 121,579, of which 38,300 live in the capital, Reykjavik. The marriage-rate is 6·6, the death-rate 9·9 and infant mortality 35·9 per 1,000 live births. The chief causes of death are old age (1·6 per 1,000), closely followed by diseases of the heart and cancer, which both reach 1·3 per 1,000. Apoplexy, tuberculosis, pneumonia and accidents all rank about the same (0·8–0·9 per 1,000). Apart from influenza and pneumonia, infectious diseases are not important causes of death. Scarlet fever and erysipelas are of a much more virulent form than in Great Britain. 229 cases of tuberculosis were notified, of which 60 were non-pulmonary, and 104 cases were fatal. School medical inspection of children especially as regards tuberculosis is compulsory. Venereal disease is notifiable, and there has not been a diminution of cases during the last ten years. Occupation by foreign troops has been followed by more employment, more money, higher prices, longer working hours, housing difficulties, more accidents in factories and on roads and increase in immorality.

Typhus Fever in Bolivia

According to the delegate of Bolivia at the eleventh Panamerican Sanitary Congress at Rio de Janeiro during September 7–15, 1942 (*Bol. Of. San. Panamer.*, 22, 590; 1943), typhus fever, which was formerly confused with typhoid fever, is an endemic disease which causes serious epidemics in Bolivia in the winter months. Its centre is the high Andean Plateau which has a million inhabitants, 90 per cent of whom are natives. The largest city affected is La Paz, which is in direct contact with the Indian population of the highlands as a trading, commercial and supply centre. The disease occurs only sporadically in the valleys, although they are inhabited by the same kind of natives as those on the plateau. During the Chaco campaign, when thousands of plateau natives were fighting among the rest of the inhabitants under lice-infested insanitary conditions, not a single case of epidemic typhus occurred, although in 1933 and 1935 the plateau was suffering from a great epidemic. During the last two years, cases of typhus have been uncommon and have been replaced by relapsing fever. The probable explanation of this is that the virus of the disease (*Rickettsia prowazeki*) is of a special type adapted to the Bolivian plateau and unable to flourish in a warmer climate, or that the lice in the valleys for some unknown reason do not transmit the disease.

Cerebrospinal Meningitis in War-time

According to the July issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, cerebrospinal meningitis recorded its most extensive outbreak in the history of the United States in 1943: the number of cases up to the end of July was more than 13,000, and the total for the year will probably exceed 17,000 cases. Practically every part of the United States has been attacked, the State most affected being Rhode Island. Earlier, the disease was at an extremely low ebb, but in 1942 new cases began to increase in number. A large proportion of the cases reported in 1943 occurred in Army camps. England has probably suffered from cerebrospinal fever more than any other belligerent in this War, especially during 1940 and 1941, when the number of cases was nearly ten times the average for the three previous years. As the result, however, of the introduction of sulpha drugs in 1943, the majority of cases are now cured and the treatment of the disease has been revolu-

tionized. In the American Army camps, the death-rate has been only 3½ per cent as compared with 34 per cent in the War of 1914–18; relapses have been virtually eliminated and the frequency of complications has been greatly reduced.

Training in Special Librarianship

THE very great increase in information services has created a demand for special librarians and information officers far in advance of the available supply of trained librarians. The Association of Special Libraries and Information Bureaux is therefore continuing to organize its emergency training in the technique of the special library by means of courses of twelve lectures given at weekly intervals, the first of which will start on February 16. Naturally such courses cannot pretend to give a complete training in librarianship; they are intended as first-aid help for inexperienced assistants in special libraries or information bureaux in place of the more thorough training not obtainable through war conditions. In the light of the experience gained in 1943, modifications have been made in the syllabus, which can be obtained on application to the General Secretary, ASLIB, 31 Museum Street, London, W.C.1. A fee of five guineas per student is charged for the course.

Clough Memorial Research Fund

THIS fund was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England, the latter defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. A sum of approximately £30 is available annually. Applications for grants for the period April 1, 1944, to March 1945 are invited. Applications should state the nature of research to be undertaken, the amount of grant desired and the specific purpose for which it will be used, and whether any other grant-in-aid has been obtained or applied for. Applications must be in the hands of the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Edinburgh, not later than March 1, 1944.

Recent Earthquakes

DURING September 1943, ten strong earthquakes were registered at the Dominion Observatory, Wellington, New Zealand. Epicentres have been determined at the Observatory as follow: September 6, near Macquarie Island; September 14, (1) near New Caledonia; (2) Samoa region; (3) region of 26° S., 175° W.; September 17, near Solomon Islands; and September 27, in the Kermedecs region. Sixteen other earthquakes and tremors were felt in New Zealand during the month. The strongest of these was Scale IV on the Modified Mercalli scale, and shocks with this intensity occurred on (1) September 3, in parts of Canterbury and Westland; (2) September 12 in Otira and near Arthur's Pass; and (3) September 28 at Eketahuna. Seismographs at Toledo in Spain registered twenty-two strong earthquakes during September 1943, the shocks of September 6, 10 and 14 being described as violent.

During the period Sept. 11–Nov. 26 inclusive, twenty strong earthquakes were registered at Kew Observatory. By far the largest ground vibration amplitudes at Kew were on Nov. 26, 1120 μ; Nov. 6, 590 μ; Oct. 23, 340 μ; and Nov. 3, 330 μ. The shock of Nov. 26 was in Turkey and has already been reported in NATURE (Dec. 11, p. 684). The shock of Nov. 6 was probably the one with epicentre just west of the island of Aroe Eilanden in the Banda Sea (lat. 5·5° S., long. 134° E.). The earthquake of October 23 probably had its epicentre 30 miles east-north-east of Sylhet in Assam, while that of November 3 probably originated 30 miles north-west of Susitna in Alaska. The last three mentioned epicentres were determined provisionally by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association on instrumental evidence. The next largest amplitudes during the period at Kew were Nov. 24, 105 μ; Oct. 24, 32 μ; Sept. 24, 28 μ; Oct. 22, 25 μ; Oct. 16, 21 μ; and Oct. 21, 17 μ. The last-named had its epicentre determined by the U.S. Coast and Geodetic Survey as being near lat. 16·5° S., long. 178° E., which is in the Pacific Ocean due north of the island of Vita Levu and due west of the island of Vanua Levu, both of the Fiji Islands group.

Announcements

THE Council of the Institute of Metals has elected four honorary members of the Institute, one each from the four principal Allied Nations: Her Excellency Madame Chiang Kai-Shek (China); Sir Lawrence Bragg (Great Britain); Dr. Irving Langmuir (United States of America); Prof. P. Kapitza (Union of Soviet Socialist Republics).

THE Astronomer Royal, Sir Harold Spencer Jones, will deliver the 1944 May Lecture of the Institute of Metals. He has chosen as his subject "Metals in the Stars".

THE Council of Newnham College, Cambridge, has awarded a Muriel Wheldale Onslow Prize for outstanding work in biology to Dr. A. B. Beakbane, of the East Malling Research Station.

PROF. J. MCLEAN THOMPSON will read a paper entitled "Towards a Physiological Interpretation of Modern Flowering", before the Linnean Society on February 10, at 2.30 p.m.

DR. PAUL HERGET, formerly assistant professor of astronomy at the University of Cincinnati, has been appointed director of Cincinnati Observatory in succession to the late Dr. Elliott Smith, and has been made professor and head of the Department of Astronomy in the University of Cincinnati. Dr. Herget, who is thirty-five years old, is an authority on celestial mechanics, having specialized on the computation of the orbits of minor planets and comets.

AT the annual meeting of the New York Academy of Sciences held on December 15, the following were elected to honorary life membership: Dr. O. T. Avery, of the Rockefeller Institute for Medical Research, New York; Prof. Alexander Fleming, professor of bacteriology, University of London (St. Mary's Hospital Medical School); Sir Frederick Gowland Hopkins, recently Sir William Dunn professor of biochemistry in the University of Cambridge; Dr. Alfred L. Kroeber, director of the Museum of Anthropology, University of California; Prof. The Svedberg, head of Physical Chemistry Institute, University of Uppsala; Prof. Arne Tiselius, professor of biochemistry, University of Uppsala.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Statistical Mechanics of Fields and the 'Apeiron'

IN view of the difficulties encountered in the quantum theory of fields, we have developed a new approach to this subject which bears a much closer resemblance to ordinary quantum mechanics of particles than the existing theories (Heisenberg and Pauli). We consider the field in a finite volume Ω as a mechanical system described by its total energy and momentum. The latter are obtained from the classical expressions for the energy-momentum densities simply by multiplication with Ω. Each field component is considered as an operator (for the whole volume Ω) and is not regarded as a function of the co-ordinates at all. Between the field components we have established very simple commutation laws, analogous to the ordinary law $pq - qp = \hbar/i$, which depend on the transformation character of the field considered. For example, for the scalar meson field (potential v, its gradient f, its time derivative g; * means Hermitean adjoint; $[a, b]$ means $ab - ba$):

$$[v, g^*] = [v^*, g] = i\frac{\hbar c}{\Omega},$$

$$[g^*, f] = [f^*, g] = k\frac{\hbar c}{\Omega}.$$

Here the vector k is just an abbreviation for the commutators; it is a dynamical variable, but in virtue of the commutation laws a constant of motion, that is, it commutes with all field quantities, with the energy and the momentum.

We have verified[1] that in this case, and also for all other known fields, these commutation laws (or in the case of electrons similar anti-commutation laws) lead, with the transcription

$$[p_x, f] = \frac{\hbar}{i}\frac{\partial f}{\partial x}, \quad [E, f] = -\frac{\hbar}{i}\frac{\partial f}{\partial t},$$

to the complete set of field equations and yield the same results as the usual quantization method (integral number of quanta with half-quantum zero energy).

But there appears a completely new feature of fundamental importance in the theory, connected with the vector k introduced above. It turns out that k corresponds to the geometrical variable 'wave vector' introduced by Fourier analysis in the usual theory. But it is here a real dynamical variable; its eigen values together with other quantum numbers define the pure states of the field. The distribution of these eigen values depends on the shape of the volume Ω, but can be assumed for a large volume to be uniform in the k_x, k_y, k_z-space (forming a cubic lattice).

In quantum mechanics it is necessary to introduce, apart from pure states, linear combinations of such, called mixtures; but it is not necessary that every possible state should appear in a mixture. (That is the main difference between our new theory and the usual one, because there each Fourier coefficient, considered as a q-number, necessarily appears, having at least its zero energy). A mixture contains in general a selection of k-points, each of which may still be occupied by any one of the quanta of the kind considered.

It is necessary to have a name for this sub-group of pure states belonging to the same k-value, which is something intermediate between the ordinary notion of a quantum (or particle) and a mechanical system. We suggest to use the word 'apeiron', introduced by the Greek philosopher Anaximander (about 550 B.C.) for the boundless and structureless primordial matter.

For a definite system (pure field) no mechanical knowledge is available to decide which apeiron may appear (which k-points are occupied by apeirons). Therefore we have to apply statistical methods. This is a new type of statistics, to be distinguished sharply from the ordinary distribution of quanta over the possible quantum states. For example, in the case of the scalar meson field referred to above, one has not only to assign the number of positive and negative mesons N_k^+, N_k^- (equal to 0, or 1, or 2, . . .) of a specified apeiron k, but also the number Δ_k (equal to 0 or 1) which indicates whether a place in the k-space is occupied by an apeiron or not. Both distributions must be made simultaneously; the N_k satisfy in this case the Bose-Einstein statistics (in the case of electrons the Fermi-Dirac statistics), while the n_k evidently always belong to the Fermi-Dirac type of statistics.

If, therefore, the total number of apeirons is a given number n, the distribution of $\bar{\Delta}_k$, the mean value of Δ_k, as a function in the k-space has the features well known from the electron theory of metals. For low temperatures all k-points are occupied up to a finite limit $|k| = k_m$, while all places with higher $|k|$ are empty. For higher temperatures this rectangular distribution curve becomes rounded off at the end, but in any event the function $\bar{\Delta}_k$ falls exponentially to zero for $|k| \to \infty$. If $\varepsilon_k\left(N_k^+, N_k^-\right)$ is the energy for the apeiron k in the occupation state N_k^+, N_k^- (for example, for the scalar meson field: $\varepsilon_k = \varepsilon_k^0\left(N_k^+ + N_k^- + 1\right)$) the total energy is $E = \sum_k \Delta_k \varepsilon_k$; it behaves as if the field were a Fermi-Dirac gas of molecules each of which was an apeiron and therefore had an infinity of states corresponding to the numbers N_k^+, N_k^- of quanta. If now Δ_k is replaced by its average $\bar{\Delta}_k$, the sum E will converge in spite of the zero energy ε_k^0 which is proportional to $|k|$.

It is to be expected that all divergent sums and integrals of the usual photon and meson theory are made convergent by the proper application of the apeiron statistics. In the case of collision phenomena, one has no thermal equilibrium; but the transition probabilities depend not only on the initial and final state but also on all possible 'intermediate' states. The cross-section integrals are extended over the statistical apeiron distribution.

The magnitude of the total number n of apeirons in thermal equilibrium has to be chosen in such a way that the self-energies of the elementary particles are correctly represented; that means that the upper limit k_m of the filled part of the k-space is connected with the radius r_0 of the electron by a relation of the kind $k_m r_0 \sim \hbar$.

The case of the electronic field can be treated in such a way that the contribution to the energy of each electron and positron is positive. But then there is a

negative zero energy, and therefore no thermal equilibrium of the apeiron is possible. This does not seem to us to be a real difficulty, because a set of electrons left to themselves is not in equilibrium. Electric clouds like those in metals exist only on account of the fact that in this case the interaction energy with other particles (which is omitted in our considerations) is large compared with the thermal energy.

Investigations on the application of this theory to the elementary particles, their masses and their mutual collision cross-sections are in progress.

MAX BORN.
H. W. PENG.

Department of Mathematical Physics,
University, Edinburgh.

[1] *Proc. Roy. Soc. Edinburgh* (in the press).

Rate of *n*-fold Accidental Coincidences

THE rate of accidental coincidences between two Geiger counters is given by $R_2 = 2.N_1.N_2.t$, where N_1, N_2 are the rates of the two single counters and t is the resolving time of the recorder. This formula is sometimes generalized for n-fold coincidences as $R_n' = N_1.N_2 \ldots N_n.(2t)^{n-1}$. This formula is, however, incorrect and it should be replaced by

$$R_n = n.N_1.N_2 \ldots N_n.t^{n-1} + \text{terms in } t^n_n. \quad . \quad (1)$$

As the formula for the rate of accidental coincidences is of practical interest, and I have not come across its derivation, a short explanation follows.

Consider a pulse of the counter 1 at the time 0. A necessary condition for this pulse to be recorded as an n-fold coincidence is that in the interval $\pm t$ each of the remaining $n - 1$ counters gives rise to at least one pulse. Neglecting all but the lowest power of t, the probability for this is

$$P = N_2.N_3 \ldots N_n.(2t)^{n-1} \quad . \quad . \quad . \quad . \quad (2)$$

The pulse of the first counter, together with the $n - 1$ pulses of the other counters, only gives rise to a coincidence if the interval between any two of the pulses is less than t. The probability Q that $n - 1$ pulses of the counters 2, 3 . . . n all inside the interval $\pm t$ are suitably arranged to give a coincidence is estimated as follows.

The $n - 1$ pulses may all be in the interval $0 - t$. The probability for this is

$$Q_1 = 2^{-(n-1)}.$$

In this case the pulses give rise to a coincidence.

Alternatively, the first pulse x of the group may be in the interval $-t', -t' + dt'$ and the remaining $n - 2$ pulses inside the interval $-t', -t' + t$. The probability for this is $(n - 1)\,(dt'/2t)2^{-(n-2)}$; the pulses again give rise to a coincidence. The probability for a coincidence while some pulses are in the interval $-t$ to 0 is thus

$$Q_2 = \int_{-t}^{0} (n-1)2^{-(n-2)}\frac{dt'}{2t} = (n-1).2^{-(n-1)}.$$

The total probability is

$$Q = Q_1 + Q_2 = 2^{-(n-1)}.n \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Thus the probability that $n - 1$ pulses fall into the interval $\pm t$, and that these pulses are suitably arranged to give a coincidence, is found from (2) and (3) as

$$P.Q = n.N_2.N_3 \ldots N_n.t^{n-1}.$$

The above expression multiplied by N_1 gives equation 1.

L. JÁNOSSY.

Physical Laboratories,
University, Manchester.

Comparison of the Behaviour of Rubber-like Materials under Constant Stress and Constant Strain Conditions

MANY experimental data have been published substantiating the use of the Nutting equation,

$$\psi = S^{\beta}\,\sigma^{-1}\,t^{k},$$

where S is shear stress, σ is strain, β, k and ψ are constants, when a series of constant stress experiments is performed. Our own as yet unpublished results confirm the equation over an even wider range of materials.

For relaxation experiments, test pieces are given a definite strain as rapidly as possible, the resulting internal stress being then allowed to dissipate with no more change of strain than is required to operate a strong spring whose deflexions, which record the stress, can be read by optical magnification.

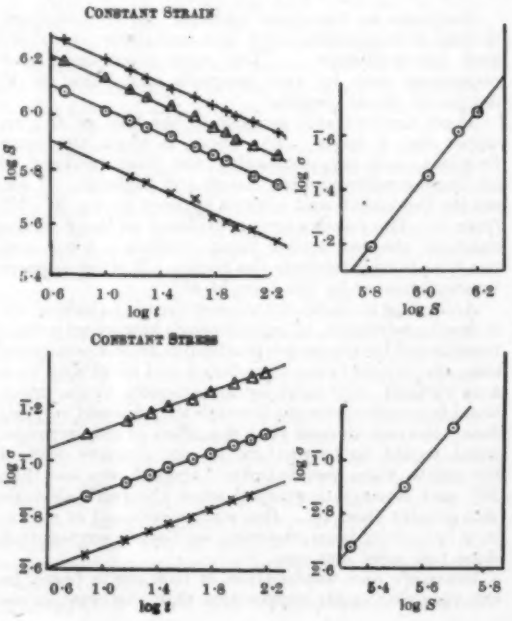
According to Maxwell's equation[1], the rate of stress dissipation should be proportional to stress itself, but many authors have shown that this is not so for most complex materials. Simha[2,3], notably, has discussed whole spectra of relaxing systems each of which is Maxwellian and has its characteristic relaxation time (t_r).

The appropriate fractional differentiation of Nutting's equation gives

$$\left(\frac{\partial S}{\partial t}\right)_{\sigma} = -\frac{k}{\beta}\frac{S}{t}.$$

Maxwell himself suggested that in complex materials t_r might well be a function of S, and the above equation is perhaps the simplest expression of this suggestion, since t_r is proportional to a power of the stress.

We have investigated a number of rubbers and rubber-like materials in tension and a few in compression, and with the exception of some very soft materials, find little if any deviation from linearity when log S is plotted against log t for a series of



constant strains. Such curvature as there may be suggests still further deviation from the Maxwell plot.

It is also interesting that the values of k, β and ψ (or $1/\zeta$, the volume of the $S:\sigma:t$ figure[4]) calculated from constant stress (compensating for the change in cross-section) and constant strain experiments are so nearly the same that differences can scarcely be much greater than experimental error. This is rather striking, since, as Scott Blair and Caffyn[5] have pointed out, in the former type of experiment k is determined from the continuous change of strain with time, whereas, in the latter, since the slope of the experimental curve is k/β, data from a series of different experiments have to be introduced. The curves deriving β are, naturally, less accurate in both experiments than are the 'continuous' curves.

This treatment seems to us to present a much simpler way of viewing the relaxation behaviour of complex materials than is the concept of a spectrum of Maxwellian components, but further data will be needed before the full extent of its applicability can be assessed.

The figure shows typical experimental curves. The derived curves, relating stress to strain for a defined time, are given on the right of the diagram.

Our thanks are due to the British Electrical and Allied Industries Research Association for a grant.

G. W. Scott Blair.
B. C. Veinoglou.
National Institute for Research in Dairying,
Shinfield,
Near Reading.
Dec. 22.

[1] Maxwell, J. C., *Phil. Mag.*, **35**, 129 (1868).
[2] Simha, R., *J. Appl. Phys.*, **13**, 201 (1942).
[3] Simha, R., *J. Phys. Chem.*, **47**, 348 (1943).
[4] Scott Blair, G. W., Nature, **152**, 412 (1943).
[5] Scott Blair, G. W., and Caffyn, J., *J. Sci. Instr.*, **19**, 88 (1942).

Ice-Crystal Haloes

Bravais, in his great memoir[1] on this subject, divides circumzenithal arcs into two classes, ordinary and extraordinary. "Les arcs circumzenithaux ordinaires sont les arcs tangents aux halos de 22 degrés et de 46 degrés."

There are two arcs tangent to the halo of 46°, an upper and a lower. The upper is much the more frequent, and unquestionably the most brilliant of all those connected with haloes and parhelia. It encircles the zenith and always appears about 20°–25° from it. The colours are as brilliant as those of the rainbow, the red border being towards the sun and the blue border towards the zenith. It often appears unaccompanied by the halo of 46°.

According to Galle, the tangent arc to the halo of 46° is due to refraction of light through hexagonal prisms terminated by planes perpendicular to the hexagonal axis, the prisms being distributed and fixed with that axis vertical. The light enters obliquely at the upper basal face and comes out through the adjacent vertical face. Bravais showed that the effect of this arrangement would be to produce an arc concave toward the zenith when the altitude of the sun was less than 20°, and concave downward when the sun's altitude was greater than 20°. But such a reversal of curvature has never been observed, so Galle's explanation does not meet the case.

Bravais's own explanation of this arc is based on the very reasonable supposition that the crystals are not fixed, but oscillating or fluttering through a small angle about the vertical. The greater the amplitude of oscillation the more are the colours of the arc mixed together, and especially so when the sun's altitude is less than 16° or greater than 28°; but the red remains pure.

In order that the crystals may flutter about their hexagonal axis, one must suppose that they are of tabular habit; for as Wood has pointed out[2], Bravais was wrong in supposing that snow crystals are in the position of least resistance while falling.

The conclusions to be drawn from all this are that: (i) the common circumzenithal arc and the arc tangent to the halo of 46° are one and the same thing; (ii) the tangent arc of the 46° halo is not invariably accompanied by the halo itself; (iii) tabular hexagonal crystals fixed as in Savile's Fig. 1[3] give rise to Galle's arc. Precisely the same type of crystal, when fluttering, gives rise to the upper tangent arc to the 46° halo.

Sidney Melmore.
Yorkshire Museum,
York.

[1] Bravais, A., *J. Ecole Roy. Polytech.*, **31**, 1 (1847).
[2] Wood, R. W., "Physical Optics" (New York, 1934), 3rd edit., p. 395.
[3] Savile, D. B. O., Nature, **153**, 25 (1944).

Hydrogen Content of the Sun and of Stars of Small Masses

The simple Cowling model of a star of small mass with a convective core and radiative envelope is of considerable importance in view of Bethe's theory of energy generation, which demands a stellar model of the convective radiative type. It appears possible to use this simple model so as to conform to Bethe's formula of energy generation on one hand and furnish an approximate value of the hydrogen content of a star of small mass on the other. For formulæ relating to the Cowling model we shall refer to Chandrasekhar's "Introduction to the Study of Stellar Structure", pp. 351–54. The constant $\varkappa_0$ in Kramers' opacity formula will be taken as $3{\cdot}9 \times 10^{25}(1-x^2)/\bar{\imath}$, where $\bar{\imath}$ is the mean guillotine factor, and x the hydrogen content; helium content being assumed zero.

It may be noted that the substitution of the observed L, M, R of a star in the Cowling model formulæ may lead to a serious discrepancy with Bethe's energy generation formula. For example, in the case of the sun the substitution of L, M, R in the formula of the Cowling model (Chandrasekhar, *loc. cit.*, ix, 206, 208 and 209) would give for $\bar{\imath} = 5$ (Strömgren):

$$T_c = 21{\cdot}4 \times 10^6 \text{ K.}, \quad \rho_c = 52{\cdot}3 \text{ gm./cm.}^3, \quad \mu = 1{\cdot}028, \quad X \sim 0{\cdot}31.$$

But if the stellar equations of equilibrium be integrated *from the centre outwards* with these T_c, ρ_c values, and the luminosity calculated by Bethe's formula be used to determine the change to radiative gradient as usual, we shall arrive at an all-convective model—there will be no radiative envelope. This situation is expected to arise quite generally for this type of adjustment.

If μ, ρ_c and T_c be given, we can, on one hand, calculate the luminosity L_{Cow} by the Cowling model formula, and also another value of the luminosity L_{Beth} by integrating Bethe's formula from the ς_c, T values inside the core within which nearly the whole of the energy generation is found to take place. Suppose now only μ is assigned, and T_c and ς_c are

so chosen that $L_{Cow} = L_{Beth}$ = luminosity of the given star. From the Cowling model formulæ (Chandrasekhar, *loc. cit.*, ix, 208, 209), we can calculate M and R for the star, which may be compared with the observed values. The adjustment of the equality of the luminosities may be made thus. We obtain

$$L_{Beth} = 4\pi\varepsilon_0\left(\frac{5k}{8\pi\mu GH}\right)^{3/2} T_c^{5/2}\rho_c^{1/2}\int_0^{\xi}\xi^{7/2}e^{-b/\xi^{1/3}}\xi^2\,d\xi$$
$$= A\rho_c^{1/2}I(\xi,T_c),$$

I representing the integral and $b = 56\times(2\times10^7/T_c)^{1/3}$. Also the Cowling model formula gives

$$L_{Cow} = B/\rho_c^{1/2},\ B = 0{\cdot}1968\times\frac{16\pi ac}{3K_0}\left(\frac{5k}{8\pi\mu GH}\right)^{1/2}T_c^{\ 8}.$$

Equating the two values of L at the interface ξ_i of the convective core, we obtain for a definite T_c the corresponding density by

$$\rho_c^{\ 3} = \frac{B}{AI(\xi_i,T_c)}.$$

By trial, T_c may now be so adjusted that the calculated luminosities agree with the given luminosity of the star.

For the sun, taking $\mu = 1$, $X \sim 0{\cdot}35$, and $\bar{t} = 5$ (Strömgren), we obtain by such an adjustment (the luminosity neglected outside the core not exceeding 5 per cent, as shown by calculation)

$T_c = 20{\cdot}3\times10^6$ K., $\rho_c = 43$ gm./cm.^{3},
$M = 2{\cdot}1\times10^{33}$ gm., $R = 7{\cdot}6\times10^{10}$ cm.

The agreement with the observed M and R is very close in this case. The integration from inside will give a convective-radiative model of the desired type. It appears that the best agreement of the Cowling model with Bethe's energy generation formula can probably be obtained in this manner. Further, it also opens up a possibility of approximately determining the hydrogen content (for zero helium content) of stars of small masses on the basis of the Cowling model by adjusting x in such a way that a fairly good agreement between the three observed and calculated stellar parameters is achieved by the above method. This, of course, tacitly assumes that the relative size and mass of the core of a star obeying Bethe's formula are approximately the same as those given by the Cowling model.

It would also appear that a solar model of the convective-radiative type in agreement with Bethe's energy generation formula should have a central temperature of about 20 million degrees (standard model), but the central density should be much lower than that suggested by the standard model.

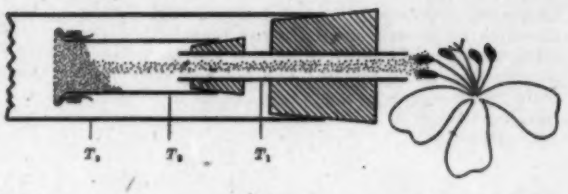
N. R. Sen.
U. Burman.

University College of Science and Technology, Calcutta.

Collection of Pollen and Artificial Wind Pollination

The collection of pollen for its immediate use or for storage is a common practice in plant breeding. No difficulties usually arise when the pollen is to be used at once, but if it is stored together with the anthers according to the usual technique, it is difficult to handle after the anthers have dried.

If pollen free from anthers is required, except in



wind-pollinated plants, it is almost impossible to separate effectively the grains from the anthers by hand. Large amounts of clean *Oenothera organensis* pollen were needed for immunological experiments; but separation by hand was impossible because of the minute threads which connect the pollen grains in the Onagraceæ. This led us to devise a new method of pollen collecting based on air suction. A household vacuum cleaner with a suitable adaptor, shown in the figure, is extremely effective for collecting large or small quantities of pollen. The adaptor can be made from a piece of ½-in. glass tube (T_1), and the top half of a 1-in. boiling tube cut into two (T_2). A piece of linen or other porous material is fixed with a rubber band around the flanged edge of the tube; a rubber bung, through which passes tube T_1, is pushed into the other end. The whole adaptor fits into the metal end of a vacuum extension tube (T_3). When the end of tube T_1 is placed near to the anthers of a flower, pollen is drawn in and trapped. By this simple device 1 gm. of clean pollen can be collected from fifty flowers of *Oenothera organensis* in less than four minutes, that is, 2·5 mgm. per anther.

After the pollen is collected it can be conveniently stored by removing the tube T_2 and corking the end. The best diameter of the collecting tube T_1 varies according to the type of flower. For Œnothera ½ in. is suitable, but for radish half this diameter is better because with the large tube, petals are collected as well. For some flowers in which the anthers are well exposed, as in apples and cherries, a bell-mouthed tube can be used with the advantage of collecting from a cluster instead of individual flowers.

The device with the air current reversed can be used as a pollinator. A press-button valve releasing staccato puffs of air must be fitted between the fan and the pollen container. In this way a flower or a whole influorescence can be pollinated with one press of the button. An insect-pollinated flower is then wind-pollinated under controlled conditions. To regulate the amount of pollen delivered it can be diluted with a 'powder' such as Lycopodium spores or talcum; the degree of dilution varying with the type of flower. The method should greatly reduce the labour of mass pollination which is necessary in the breeding of fruit and forest trees in the temperate countries and in the breeding of dates, sugar-cane and bananas in the tropics. The increasing utilization of hybrid seed production in vegetables and fruit will also require mass pollination methods. Lack of adequate cross-pollination which may be due either to the planting of large blocks of one variety of fruit tree or to low insect activity has led occasionally to the use of hand collection and pollination in some 100-acre orchards[1]. If artificial pollination has to be resorted to on a big scale then the present method could be used with advantage. A similar method has been used on grape vines by spraying the flowers with a suspension of pollen in water[2].

Furthermore it will now be possible to measure

accurately and quickly the pollen production of plants, of which at present there is little knowledge. Such information is of biological interest in relation to the mating systems of plants. The pollen production of fruit tree varieties is of practical value in relation to insect activity and the efficiency of varieties as pollinators.

D. LEWIS.
L. F. LA COUR.
John Innes Horticultural Institution,
Merton Park, London, S.W.19.
Dec. 23.

[1] Gowley, J. H., and Howlett, F. S., "Modern Fruit Production" (Macmillan, New York, 1941).
[2] Dunne, T. C., *J. Dept. Agric. W. Austr.*, **19**, 210 (1942).

Leaf Lipids of Forage Grasses and Clovers

DURING the past five years, the lipids of forage grasses and clovers have been investigated in this laboratory. The results so far obtained have indicated the complexity of the lipids as well as the need for careful preservation and preparation of the samples.

The results of examination for lipid constituents of ten cocksfoot (*Dactylis glomerata*) samples collected at different periods may be summarized as follows:

	Total lipids	Lipids soluble in acetone at 0° C.			Waxes	Phospholipids
		Total	Fatty acids	Unsaponifiable		
Mean percentage on dry matter	6·12	5·06	3·13	0·96	0·86	0·20
Standard deviation	1·05	0·83	0·70	0·17	0·09	0·07

The fatty acids, comprising 2·15–4·03 per cent of the dry weight, were found by ester fractionation to have the following mean composition:

	Saturated			
	C_{16}	C_{18}	C_{20}	as C_{22}
Weight per cent	1·4	11·2	2·6	1·5

	Unsaturated		
	C_{16}	C_{18}	C_{20}
Weight per cent	0·4 (2·0 H)	6·4 (2·0 H)	76·5 (5·1 H)

Smith and Chibnall[1] deduced from bromination experiments that the unsaturated acids of cocksfoot consisted of approximately two thirds octadecadienoic acid and one third linolenic acid. In this work, however, the mean unsaturation of the C_{18} esters indicated approximately equal proportions of these two acids. In addition, dihydroxystearic acid (m.p. 131–132° and not depressed by admixture with authentic dihydroxystearic acid m.p. 132°) was prepared by oxidation of the acids from the C_{18} unsaturated methyl esters insoluble in acetone at −78° C., the yield corresponding to approximately 0·6 per cent oleic acid in the C_{18} unsaturated acids. By oxidation of a concentrate of C_{16} unsaturated acids, dihydroxypalmitic acid (m.p. 122–123°; m.p. 123–124° admixed with authentic dihydroxypalmitic acid m.p. 125°) was also prepared.

The low yield of phospholipids (0·1–0·3 per cent of the dry weight) found for cocksfoot (*Dactylis glomerata*) and for rye grass (*Lolium perenne*) preserved in cold alcohol or dried in a current of air at 35° or 70° C. is in agreement with the findings of previous workers[2]. Freshly-cut cocksfoot or ryegrass preserved by dropping into boiling alcohol contained, however, 1·5–1·7 per cent phospholipid. With boiling alcohol treatment the free fatty acid content of the lipids insoluble in acetone at 0° C., expressed as oleic acid, was 6–14 per cent as compared with the higher values of 30–37 per cent obtained by other treatments. In the case of white clover (*Trifolium repens*), similar high phospholipid values were obtained for samples preserved in boiling alcohol or dried in a current of air to 70° C.

The isolated phospholipids of cocksfoot, rye grass and clover contained usually *ca.* 2·0 per cent phosphorus. Relatively pure lecithin-cephalin fractions (P = 3·40 per cent, N = 1·4 per cent) amounting to 15 per cent of the total phospholipid were readily obtained. However, attempts to prepare pure lead phosphatidate, the crude preparations of which amounted to 10 per cent of the total phospholipid, were unsuccessful. Application of similar technique to rape phospholipids yielded without difficulty almost pure lead phosphatidate (P = 3·33 per cent, ash 32·5 per cent). The highest yields of the phospholipids were obtained by boiling the cold-acetone-insoluble lipids with ten volumes of acetone, cooling to 35° C. and decanting the waxes which remained in solution. The traces of phospholipid retained in the wax fraction were afterwards removed by crystallization from ether at − 20° C.

In general, the phospholipid fatty acid composition was found to resemble that of the corresponding glyceride, with the exception that the mean saturation of the C_{18} unsaturated acids tended to be lower (3·7–4·8 H) than in the case of the glycerides (5·0–5·3 H).

F. B. SHORLAND.
Chemistry Section,
Animal Research Division,
Department of Agriculture,
Wellington, N.Z.
Oct. 20.

[1] Smith and Chibnall, *Biochem. J.*, **26**, 218 (1932).
[2] Smith and Chibnall, *Biochem. J.*, **26**, 1345 (1932).

Acetate Utilization for Maintenance of Motility of Bull Spermatozoa

THE oxidation of acetate by mammalian tissue *in vitro* has been demonstrated; but comparatively little is known concerning the pathway of its oxidation or the possibility of its oxidation being coupled with phosphorylation. Recently Barcroft, McAnally and Phillipson[1] showed that acetate maintained the beat of the perfused rabbit's heart. Their demonstration suggests the ability of acetate to furnish energy for the maintenance of function in this tissue.

In view of their results, it seemed desirable to present data which have been obtained on the utilization of acetate by spermatozoa. It has been shown that washed, ejaculated bull spermatozoa suspended in phosphate-saline maintain their motility by the oxidation of intracellular phospholipids[2]. The addition of other metabolites to such sperm suspensions results in no further increase in respiration. If, however, the oxidation of the lipid is inhibited by 2,4-dinitrophenol, the utilization of various added metabolites may be readily demonstrated[3]. With epididymal spermatozoa the endogenous respiration is low and the effect of added metabolites is immediately shown. The effect of acetate on respiration and motility of both epididymal and of ejaculated

EFFECT OF ACETATE ON RESPIRATION AND MOTILITY OF BULL SPERMATOZOA.

Additions	Zo_2	Motility at 2 hours
Ejaculated spermatozoa :		
None	−25	++++
2,4-Dinitrophenol, 0·0001 *M*	−10	0
Acetate, 0·02 *M*	−23	++++
Acetate, plus 2,4-dinitrophenol	−28	+++
Pyruvate, 0·02 *M*	−26	++++
Pyruvate, plus 2,4-dinitrophenol	−30	+++
Epididymal spermatozoa :		
None	−7	++
Acetate	−13	++++
Pyruvate	−16	++++

Zo_2 = c.mm. oxygen/10^8 cells/hour. Respiration was measured in the Warburg apparatus at 37° as described previously[4]. Specimens were removed from the Warburg flasks after 2 hours to observe motility.

spermatozoa treated with 2,4-dinitrophenol is shown in the accompanying table. For comparative purposes data for pyruvate are included for each type of spermatozoa listed in the table. Stimulation of respiration and prolongation of motility, by acetate, were obtained with certain collections of ejaculated spermatozoa by storing at room temperature until the intracellular reserves had been partially depleted. The utilization of acetate as well as of the intracellular lipid reserve[5] is completely inhibited by malonate. Evidence to be presented elsewhere indicates that the mechanism of lipid metabolism in the sperm follows a pathway similar to the *iso*citric acid cycle. Breusch[6] has recently claimed that citric acid is an intermediate in fat metabolism. The presence of an active aconitase in the enzyme preparations from spermatozoa produces an equilibrium of *iso*citric, *cis*-aconitic and citric acids and prevents the identifying of the primary condensation product. Acetate may enter such a cycle but the mechanism is as yet undetermined. It has been shown that acetate increases the respiration and supports motility of epididymal, and of 2,4-dinitrophenol-treated ejaculated spermatozoa of the bull. This work was supported by a grant from the National Committee on Maternal Health.

HENRY A. LARDY.
PAUL H. PHILLIPS.

Department of Biochemistry,
University of Wisconsin,
Madison.
Dec. 9.

[1] Barcroft, J., McAnally, R., and Phillipson, A., NATURE, **151**, 204 (1943).
[2] Lardy, H. A., and Phillips, P. H., *Amer. J. Physiol.*, **138**, 602 (1941); **134**, 542 (1941).
[3] Lardy, H. A., and Phillips, P. H., *J. Biol. Chem.*, **149**, 177 (1943).
[4] Lardy, H. A., and Phillips, P. H., *Amer. J. Physiol.*, **138**, 741 (1943).
[5] Lardy, H. A., and Phillips, P. H., *J. Biol. Chem.*, **149**, 333 (1943).
[6] Breusch, F. L., *Science*, **97**, 490 (1943).

Effect of Factors Influencing Mutability

UNSTABLE genes are found to be very suitable for the study of many factors influencing mutability, because high-mutability stock yields significant results for a number of flies examined much lower than with standard *ClB* method. In this study the influence of chemicals on germinal mutations of unstable gene *mt-3a* (*Drosophila virilis*)[1] was investigated. Altogether 79,011 flies were examined and 3,617 mutants found.

Flies raised on food containing 0·1 per cent copper sulphate or on food made alkaline (*p*H 9–14) by means of sodium hydroxide, or flies from eggs and larvæ treated with sodium hydroxide or ammonium hydroxide, show a highly significant *decrease* of mutability; this was found both in mass and in individual cultures; the effect applies also to genes the mutability of which is influenced by other genes.

The chemicals themselves probably could not penetrate[2] into the nuclei of the germ cells, and therefore the decrease of mutability must have been the general effect of *disturbances* in the organism. A similar decrease of mutability in unstable genes, as a result of temperature disturbances, has been also reported[3,4].

Since in 'stable' genes similar chemical treatments result in an opposite effect (increase)[5], I reach the following conclusion: when a given physical or chemical disturbance is able to change the mutability, the *change* will be an *increase* in 'stable' (wild) genes where the natural selection favours the lowest feasible mutability-rate[6] (close to optimum stability); whereas, it will be a *decrease* in 'unstable' genes the mutability of which is close to the highest feasible (optimum unstability).

I wish to express my thanks to Dr. M. Demerec, Carnegie Institution, Cold Spring Harbor, for his valuable suggestions in the course of this work.

S. ZAMENHOF.

Biological Laboratory,
Cold Spring Harbor,
New York.

[1] Demerec, M., *Proc. U.S. Nat. Acad. Sci.*, **12**, 687 (1923).
[2] Zamenhof, S., and Demerec, M., *Amer. Nat.*, **77**, 380 (1943).
[3] Rhoades, M. M., *Cold Spring Harbor Symposia Quant. Biol.*, **9**, 138 (1941).
[4] Fabergé, A. C., and Beale, G. H., *J. Genet.*, **43**, 173 (1942).
[5] Review in Dobzhansky, T., "Genetics and the Origin of Species", second edition (Columbia University Press, New York, 1941).
[6] Sturtevant, A. H., *Quart. Rev. Biol.*, **12**, 464 (1937).

Physico-Chemical Nature of Bacteriolysis

WITHIN recent years, much attention has been paid to the antibacterial action of naturally occurring and synthetic products. The principal problem to be solved is that of the nature of the primary effect on the bacterial cell of the bacteriolytic or bacteriostatic agent. By such studies the intimate nature of the bacterial cytolysis may be illuminated and a practical means of early diagnosis of the lytic process may be forthcoming.

Hewitt[1] claims that visible lysis induced by the action of lysozyme is preceded by an activation of the bacterial dehydrases, this being shown by the fall in the aerobic redox potential of bacterial suspensions shortly after the addition of lysozyme. In support of this, Dr. Subkova in this Institute has shown that the oxygen uptake of bacteria (*M. lysodeikticus*) rises prior to the onset of lysis induced by lysozyme. No drift in redox potential occurs, however, when bacteriophage is added to bacterial suspensions.

Theoretical considerations led me to the opinion that the effects observed by Hewitt might be explained on the basis of the changes in *p*H occurring when lysozyme preparations (*p*H 7·2) are added to bacterial suspensions (*p*H 6·3–6·4). It can actually be shown that mere alkalinization of a bacterial suspension produces a negative potential drift, while acidification produces an opposite effect. By combining both kinds of procedure one may repeatedly

reproduce the course of the potential curve as pictured by Hewitt. Moreover, lysozyme inactivated by boiling causes the same change in redox potential as active lysozyme although no lysis occurs, and if the *p*H of the lysozyme is adjusted before addition to that of the bacterial suspension, no drift in redox potential occurs on mixing, though lysis takes place.

Since many of the most important properties of bacteria such as virulence, antigenic capacity, etc., reside in the surface layer, it was considered desirable to study the electrokinetic potential in relation to lysis. The experiments were made in collaboration with Dr. E. A. Moldavskaya, a Northrop microelectrophoretic chamber as modified by Abramson being utilized.

Preliminary experiments show that as soon as the lytic agent is added to a bacterial suspension, there is a sudden rise in the negative potential which persists for 5–10 minutes, after which the potential tends to return to the initial level. This phenomenon has been observed with lysozyme and in mixtures of *B. coli* and staphylococci with their respective phages. With *B. subtilis* the potential changes are in the opposite direction. The inactivated lytic agent does not produce any such effect, neither does the active agent affect the potential of quartz particles suspended in a similar medium. For bacteriophages the effect is specific.

The time relations of the potential changes are the same for lysozyme and bacteriophage. Since with lysozyme many of the cells are lysed instantly but with phage no detectable lysis occurs during the period occupied by the measurements, the possibility that the potential changes are produced by the adsorption of lytic products on to the surface of intact cells is eliminated. It may be concluded that the change in the potential of the bacterial surface accompanies lysis and is not due to an effect of contaminating impurities added with the lytic agent or to substances derived from lysed cells.

The study is being pursued in relation to bacteriostatic agents such as gramicidin and penicillin.

W. A. DORFMAN.

All Union Institute of Experimental Medicine,
Moscow.

[1] Hewitt, L. F., *Biochem. J.*, **25**, 1452 (1931).

Antibiotics and Competition

IN the attention rightly directed towards the very great practical potentialities of the bacteriostatics, which the researches of Prof. H. W. Florey and his collaborators have done so much to develop, the scientific interest of these as part of the mechanism of competition is in danger of being ignored.

It may well be that water-soluble antibiotics are of widespread occurrence as one of the factors concerned in the competition of both lower and higher organisms occupying the same substratum.

In an address to the British Ecological Society in 1929, I directed attention to the very marked check to the growth of the root systems of higher plants which could result from the presence of other species. Afterwards the Canadian botanist Pavlychenko, employing a team of workers, was able to obtain quantitative expression for this phenomenon, and showed that in cereals the effect of competition on root growth might bring about a reduction to less than 1/3 per cent of that when competition was absent.

S. C. Varma, working in my laboratory, produced evidence that the depression of root-growth in competition was due to soluble substances and that the effects of these varied with the species concerned[1]. The same investigator employing various species of Hypericum obtained striking evidence not only of the individuality of the relation between species but also of the modifying influence of soil reaction upon the effect of competition on root development[2].

The evidence that Prof. Florey has obtained respecting the sensitiveness of penicillin to acidity or alkalinity may perhaps indicate one way in which reaction of the substrate may exercise its profound effects, not only on bacteria but also on higher plants. There is the possibility that the soluble antibiotics from the root systems of higher plants may have their practical applications; but the object of this letter is primarily to direct attention to the importance which these studies on antibiotics may have in elucidating the more fundamental aspects of the competition problem, a realization of which might well result in the accretion of valuable data.

E. J. SALISBURY.

Royal Botanic Gardens,
Kew.

[1] *Ann. Bot.*, N.S., **2**, 203 (1938).
[2] Unpublished thesis.

Penicillin Dressings

Robinson and Wallace[1] have recently described a method of treating surface wounds with dressings of absorbent gauze inoculated with *Penicillium notatum*, the organism producing penicillin.

We have carried out preliminary experiments with a modification of this method, and the results (some two dozen cases have so far been treated) have been so astonishingly good that we feel wider tests are highly desirable. Large burnt areas covered with pus have cleared up in two or three days, and subsequent healing has been rapid.

Although the technique devised at the outset has given uniformly excellent results, further experiments are in hand to determine the optimum methods of production and application of the dressings.

We attach great importance to testing the bacteriostatic activity of each batch made, and to careful microbiological and clinical control throughout. With this proviso, the application of these dressings to superficial wounds appears to us to be free from risks; whether the method is suitable for deeper wounds is a matter for further research, and may present complications.

Dressings of the above type can quickly be prepared in large quantities, and at negligible cost.

Since one cannot predict how long will elapse before the industrial production of cheap, abundant and reliable penicillin, it appears to us that a fuller investigation of the 'live dressing' technique is a matter of the greatest urgency.

L. D. GALLOWAY.

4 Hanway Place,
London, W.1.

A. J. HOBSON.

46 Barham Road,
London, S.W.20.
Jan. 17.

[1] *Science*, **98**, 329 (1943).

GESTURE ORIGIN OF INDO-EUROPEAN LANGUAGES

By Prof. ALEXANDER JÓHANNESSON
University of Iceland

AMONG the many theories which in course of time have been propounded on the origin of language, that put forward by Sir Richard Paget in his work "Human Speech" (1930) is one which is most probable, and likely, to revolutionize philology. In this work he asserts that the speaking organs imitated the bodily gestures, especially those of the hands, with which *Homo sapiens* some 30,000 years ago tried to make himself comprehensible and to understand his neighbours. This theory was put forward first in a treatise on the Polynesian language by Dr. J. Rae in 1862 (reprinted in "Human Speech"). Sir Richard Paget emphasizes that the natural sign-language of those born deaf, and that of the Red Indians, may give useful information as to the stages by which the human language was developed. It is evident that if the gesture theory is right, a valuable aid may be rendered by the study of sign-language all over the world.

I have for many years been occupied with a study on the same problem, and the University of Reykjavik has just published my work on the subject: "Um frumtungu Indogermana og frumheimkynni: On the primitive speech of the Indo-European people and their first home". I had nearly completed my work when I read Sir Richard Paget's book, and had not seen his other book on the same subject: "This English" (1935). As my researches had led me in a surprising manner along the same paths as Sir Richard had trod, I feel impelled to record the main results of my own investigations. Of the 2,200 Indo-European roots constructed by philologists, the most important class can be explained as an imitation by the speech organs of the movements of the hands, as the first man began to speak; another class consists of roots imitating the sounds in Nature, the crying of animals, the whistling of the wind, the roaring of the sea, etc.; a third part, which is insignificant, is due to the spontaneous utterances of emotions, such as laughing, weeping, coughing, sneezing, etc.

On the basis of these fundamental conclusions, I have built up a system which embodies the labials, the dentals, the liquids and the gutturals. If the theory is correct, words beginning with labials ought to signify to babble, to keep, to retain and to destroy, if the lips are closed (for example, English flap, babble, blather; fat, fadge (= bundle); Lat. paciscor; O.E. beadu, "battle"; Lat. findo; English boat, bang, barrow). If the lips are open, the labials mean to emanate, to respire with noise (Greek πιμπρημι, πνεω; O.E. fnæsettan), and if the cheeks at the same time are puffed out, to inflate, to distend (Lat. pollex; English pat, bole, pit, bud, bold, etc.).

The roots beginning with dentals have a similar meaning, as the first man either pressed his teeth together, or let the tip of the tongue rest against them: to touch or retain (Lat. tango; English thrive, take), to destroy (English thwite (=cut chips), thong, tough, dingle, dangle), to extend and to draw (in this case the tongue has been drawn back from the teeth to the palate: Lat. tenere, ducere; English thin, tight, team), and finally to shudder (if combined with *r*, which was originally cacuminal, hard and vibrating); English thread, thrave (=herd); Greek ἱρεω; Russian drožu, "shudder". In considering the consonants and the vowels combined, I have given a new explanation of the so-called "ablaut": the vowel *e* indicates originally an imitation of pointing at oneself (as *e* in Lat ego "I"), whereas *u* is the imitation of stretching out the hand to point at the other person (as *u* in Lat. tu, "thou"). The vowels *u* and *o* are similar and the variation of *e* and *o* (as seen especially in Greek) is to express what is present and absent in time and space. For that reason *e* is predominant in the present tense and *o* in the past. The vowel *i* means something little, as has already been shown by many philologists (Otto Jespersen and others). If *e* is combined with an *i*, the ablaut *ei* (comp. Greek *ει*) means something emanating from *e* (myself), which is significant for the first class of the strong verbs. A very great proportion of all strong verbs of the first class mean to remove from some one: Greek κιω; Lat. eo, ivi "to go"; English write, glide, etc. The "ablaut" *e* + *u* is an oral imitation of a circulating movement, and therefore a great many of the second class of strong verbs signify something round, as Greek κῦμα, "sea"; English cudgel (from kuggila-), cog, kite (from kyte, "a round stomach"), cob, hoop, etc.

The consonant *s* is an imitation of sounds in Nature, such as the running of water, the howling of the sea, the whistling of the wind. Of 330 Indo-European roots beginning with *s*, 93 show the meaning: (1) to flow (of water) as sea, cinders, (O.E. sinder), stale, snite (= blow the nose), stream; Greek ἅιμα (from saima, "blood"; Lat. serum; Serbian sipiti, "flows out"; Celtic sruaim, "stream", etc.; (2) to put in motion (of water or fluids) as Lat. salum "swelling sea"; O.E. sēoðan (German sieden), Greek ῥοδος (from σροδος) "waving sea", etc.; (3) to fetch up or drink: swell (German schlucken); (4) every sort of movement: to creep, glide, curve, turn, throw, shake, pull, contract, dangle, let fall: seal (German Seehund), snake, slide, sledge, slough, swipe, swim, shoot, scrag, shrimp, sparkle (O.E. spurnan, sow), sag, etc. The roots beginning with a guttural signify "to gape" (in the beginning "to open the mouth", to receive food) as chew, gag, Lat. hio, gustus, etc. The roots beginning with liquids (*r* or *l*) have varying meanings. The *r* roots especially signify to make noise (roar; Sanskrit rásati, "cries"; Greek ῥημα, "speech, word"), to put in movement (Lat. rabies, rota; English run, rise), to tear (English rot; O.E. rift; Lat. rima, rumpo), to stretch, to erect (reach, right, rank; Lat. rex, rogus). The imitation of the gestures of the hand is evident in the roots with *r*, which signify to erect: in those roots formed with *r* + vowel (*e* or *i*, as *i* is a high vowel) + guttural the tongue is moved upwards to the palate. The roots beginning with *l* signify especially "to move, to withdraw" (lode, last; Lat. lira, comp. delīrus), to glide slowly (Lat. libo, liqueo; English liquid), to lie without movement (lie; Lat. lacus), to lick (Lat. labium; German lecken; O.E. liccian) and to play (little, lungs, light; Lat. lacertus, "arm"—the tongue plays against the palate).

After having examined the onomatopoetica (imitations of different cries of animals as birds, dogs, wolves, frogs, sheep, cats and pigs and those imitating every sort of noise), the total number of roots thus explained comes up to 500, or nearly a quarter of the whole material. Those 500 roots are the first basis of the Indo-European languages. They all have a concrete meaning, whereas most of the others are abstract. It is the object of further investigations

to show how the roots with concrete meaning have developed an abstract meaning. The aim of philology in the last hundred years has been to investigate every language of the Indo-European family and, of course, many others in order to collect a great store of words and compare them for the purpose of reconstructing the Pregermanic language as well as the Indo-European, to find out the laws, which at all times cause the changes of forms, meanings, etc. Philologists have been satisfied with massing together an immense store of knowledge. Philology must become a scientific study in the sense of Darwin's theory, and every group of languages in the world must be investigated on the same principles of evolution. I am convinced, having worked in philology for more than thirty years, that no explanation of the origin of languages is acceptable except the gesture theory, an imitation of the gestures of *Homo sapiens*, before he learned to employ his speech organs. The difficulties which arise in investigating languages such as Chinese, Japanese, etc., on these principles of imitations, are due to the fact that the change of form of a gestural word is usually the result of making the original gesture in a different manner. A long time must elapse before philology is led into these new paths. Philologists, like many others, have a fear of being thought unorthodox and prefer to walk on well-beaten paths.

BRITISH SOCIETY OF ANIMAL PRODUCTION

FOR many years there has flourished in the United States a Society of Animal Production, which has recently started to publish a full journal, the *Journal of Animal Science*. Similar societies have been formed in other countries, and on January 6, a corresponding British organization came into being. Much of the future organization of the Society was left to a provisional committee comprising Dr. John Hammond—who took the chair at the opening meeting—Prof. Wm. C. Miller, Prof. R. G. White, Dr. A. B. Fowler and Messrs. Alec Hobson, James Mackintosh and W. A. Stewart. Dr. J. E. Nichols, who had been responsible for most of the preliminary arrangements, was elected secretary-treasurer.

The opening meeting, held at the London School of Hygiene and Tropical Medicine, took the form of an all-day discussion on cattle-breeding policies, and the subject-matter was appropriately divided up into dairy cattle, dual-purpose cattle and beef cattle. In each section there was an opening paper, followed by a discussion.

Reading the paper on dairy cattle, Dr. Joseph Edwards compared present-day policies in Great Britain with the much more enterprising schemes in the United States. Artificial insemination is providing a real contribution to mass improvement schemes in the United States and, during 1943, the Artificial Insemination Society had arranged the servicing of 182,524 cows by 574 bulls. This is to be compared with the total of only 41,500 cows serviced by no fewer than 1,230 bulls in the co-operative Dairy Bull Associations. Dr. Edwards recently accompanied Mr. J. N. Ritchie, of the Ministry of Agriculture's veterinary service, on a survey of artificial insemination practices in the United States and would shortly submit with him a comprehensive report on the subject.

By whatever means the dairy farmer obtains improved stock, one point is fundamental, namely, that better breeding calls for better environment, if the improved genetic potentialities are to be exploited. It is noteworthy that most members of the American artificial insemination societies now feel that they have dairy cattle worthy of attention, and are demanding information on all up-to-date husbandry methods. It is desirable that the breed societies in Great Britain should play a much more important part in pedigree breeding than they are doing at present. In the United States, agreement between the dairy cattle breed societies has been attained on such matters as uniform rules for registration of cattle bred by artificial insemination and type-judging for all breeds. They also support research work destined to help them, for example, on the blood-typing parentage test, and they keep the bulk of pedigree records. In Great Britain, the élite dairy herds are a heritage and should be carefully protected against dispersal, besides being utilized for statistical research.

The paper on dual-purpose cattle was read by Mr. W. S. Mansfield, who stressed how animals of this type fit into mixed farming such as that practised by himself at the University Farm, Cambridge. In his own case, milk sales form the second largest item and yet are responsible for only one seventh of the total net sales, which are otherwise composed of returns from corn, potatoes, sugar beet, seed, mutton, pork, beef, horses and poultry. Cows on such a farm must be capable of (1) converting bulky by-products into milk; (2) making manure for the arable land; and (3) breeding heifer-calves worth rearing for the dairy and bull-calves worth rearing for beef. Such functions can be performed satisfactorily only by dual-purpose cattle.

Unfortunately, there is a dearth of dual-purpose cattle, and methods now adopted do not permit of breeding true. The only real solution is to practise inbreeding or long-continued line-breeding. Careful management of dual-purpose heifers is most important: it is almost impossible to do the heifer calves too well for the first six months of life, because, if they are then transferred to a much lower plane of nutrition, they will continue to grow well for another eighteen months, will be ready to mate at twenty months, and at calving will be as large as heifers six to nine months older that have been fed inadequately as calves.

Mr. W. A. Stewart, reading the paper on beef cattle, dealt first with sources of supply, and stressed that, on lowland farms, it is most uneconomical to rear only one calf per cow. Among methods of multiple rearing, there is that practised during the first half of the nineteenth century by Hugh Watson, of Aberdeen Angus fame; but there is also Mr. H. R. Overman's system, namely, bulling a certain number of heifers, selling the greater number when freshly calved, and rearing all the calves on those remaining.

Ley farming is likely to have beneficial effects upon the numbers and quality of beef cattle that could be fattened in certain areas, for example, the Welland Valley, where formerly graziers required old bullocks for the pastures but in future would be able to fatten younger cattle.

It is essential that the milk-producing qualities of British beef-breed cows should be increased. This can best be done by making full use of bulls that are proved 'getters', not only of offspring of a high standard of beef conformation and maturity, but also

of daughters that are good milkers. It is not impossible to aim at 300–400-gallon lactations even among cows of high-class beef type.

The Argentine markets have been responsible for the appearance in sale- and show-rings of a small, thick, fine-quality, fine-boned, short-legged type of animal. This is not necessarily the type desired by the average British farmer, and it is likely that a middle course will be adopted, and that animals will be produced which give reasonable weight for age but are early maturing. ALASTAIR N. WORDEN.

PLYWOOD ADHESIVES AND LININGS

ATTENTION has already been directed in NATURE to the important research work carried out in the Forest Research Institute, Dehra Dun, India, in connexion with the construction of plywood containers to replace metal drums and other containers imported in large quantities before the War, the incidence of the latter bringing this source of supply to an end. In connexion with this research, investigations had to be instituted into possible new adhesives. The Wood Preservation Section of the Institute has done important work on the development of maize and ground-nut proteins as adhesives, and on various lining compounds for proofing plywood containers and drums. The plywood and other industries have been affected by the shortage and high prices of casein, and this work on the protein of maize, which is a waste product of starch manufacture, will not only enable this waste product to be used but also will give an adhesive at a competitive price.

Two Indian Forest Leaflets (Utilization), Nos. 40 and 52 (For. Res. Inst., Dehra Dun, 1943), deal with plywood adhesives. In Leaflet No. 40 (Pp. ii+14. 9d.) the result of research has shown that prolamins, isolated from Indian cereals, are equally suitable for the preparation of water-resistant plywood adhesives. This type of adhesive can be prepared by adding to a 20 per cent suspension of prolamin in 80 per cent alcohol, 5 per cent of formaldehyde (40 per cent formalin). One per cent of ammonia or an organic acid such as acetic, tannic, etc., may be added as a catalyst. The adhesive suspension so prepared should be applied within twenty-four hours of its preparation. Veneers coated with these adhesives, after drying at room temperature, should be pressed together at a temperature of 250–300° F. for a suitable period (10 minutes for 3/16 in. plywood) at a pressure of 200 lb. per sq. in.

Leaflet No. 52 (Pp. ii+6. 5d.) deals with researches with the object of utilizing the wholemeal and proteins of sunn-hemp seed (*Crotolaria juncea*) for plywood adhesives. For commercial plywood (not requiring a high degree of water resistance) a wholemeal lime silicate formula with rosin, copper sulphate and tannic acid has been found suitable. With the protein, lime silicate and borax-formaldehyde formulæ have been found suitable for the preparation of water-resistant plywood.

Leaflet No. 49 (Pp. ii+10. 5d.) discusses the results of experiments on various types of inner linings suitable for plywood containers for storage of various commodities such as greases, liquids and so forth. A variety of inner coatings have been tried and tested; some were found good for certain materials, others for other contents, but a universal leak-proof coating has not yet proved attainable. The requirements demanded by such a lining are nearly as variable as the nature of the commodities themselves. The linings so far tried, nine in number, are: animal glue-treacle composition, prolamin formaldehyde glue, casein or vegetable protein-formaldehyde glue, paraffin wax, bituminous paint, shellac varnish, shellac-melamine composition, phenol-formaldehyde resin and cashew shell oil varnish. The methods of preparation and application of these linings are described in the leaflet.

LOCATING BURIED CABLES ELECTRICALLY

FOR the protection of buried inter-city cables against damage by lightning, it is sometimes necessary to install copper shield wires above a cable already in the ground, and the precise route of the cable must be determined so that the shield wires can be correctly placed. It is also important to know the depth of the cable, so that damage to it may be avoided while installing the shield wires. This can now be done electrically with a simple device which consists of coils that pick up a tone which has been applied to the cable sheath. The device is described in an article by R. M. C. Greenidge (*Bell Lab. Rec.*, 22, No. 3; November 1943).

The device carries three coils, a fixed locating coil *A*, a fixed direction coil *B* and a pivoted depth coil *C* mounted on a crossbar attached to a vertical rod which supports a graduated quadrant scale *S* and has a spirit-level on its upper end. A handle is used to adjust the apparatus by forcing a spike into the ground. A selector switch connects any one of the three coils to an amplifier and detector circuit, which is multiple connected to the coil circuits. A pointer *P* indicates the setting of the depth coil *C*, and a shaft which slides vertically permits levelling the apparatus.

The test current is generated by the buzzer of a 20C. test set. One of its terminals is connected to the cable sheath at a pressure-testing valve and the other to an earth rod located 50–100 ft. from the cable. Current flows along the sheath in both directions, and through earth to the earth rod. With the amplifier in operation and earphones used as detector, the selector switch is set to close the locating coil circuit and the apparatus is carried across the path of the cable. When coil *A* comes directly over the cable, a null position is reached, and at this point the spike is pushed into the ground. By setting the selector switch to close coil *B* circuit and rotating the apparatus round the spike, the null point of coil *B* is found. In this position the horizontal bar on which coil *C* is located is at right angles to the path of the cable. Adjusting the sliding shaft then levels the device, after which the selector switch is set to close coil *C* circuit and the depth coil rotated on its pivot for the null point. The reading on the scale, as indicated by the pointer, is the distance of the centre of the cable below the surface. If r is the radius of the cable, h the height of the coils above the ground, l the distance between the coils *A* and *C*, and d the depth of the cable, $d = l \cot \theta - k$, where $k = r + h$ and θ is the angle which the pointer *P* makes with the horizontal when coil *C* is in its null position. By this formula the quadrant scale *S* can be calibrated for depth.

The depth indicator is usually handled by a team

of three men. Where the cable is buried to a depth of 25 in. or more, measurements are taken every 50 ft. and flags are placed to mark the path of the cable. As a check on the accuracy of the survey and also of the guiding of the tractor and plough used for laying the shield wires, test holes are dug at intervals to expose the wires and cable after the plough has passed. In most cases the two wires are found to straddle the cable almost exactly and are about 4 in. distant on each side, but in some instances they are off centre by 2–3 in. As a result of the depth survey and the precautions during the ploughing, damage to the cable is completely avoided.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, February 5

NUTRITION SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 10.30 a.m.—Conference on "Budgetary and Dietary Surveys of Families and Individuals", Part 1.

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Sir Edmund O. Teale: "The Geology and Scenery of Tanganyika Territory, East Africa".

INSTITUTE OF PHYSICS (MANCHESTER AND DISTRICT BRANCH) (at the Christie Hospital and Holt Radium Institute, Wilmslow Road, Withington, Manchester), at 2.30 p.m.—Prof. W. V. Mayneord: "Physical Principles of X-Ray Therapy".

Monday, February 7

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—Sir Robert Reid: "The Excluded Areas of Assam".

Tuesday, February 8

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Werner Kissling: "Eriskay" (Sound Film).

INSTITUTION OF CHEMICAL ENGINEERS (joint meeting with the CHEMICAL ENGINEERING GROUP) (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. J. Arthur Reavell: "Infra-Red Radiation and its relation to Distillation and Evaporation Problems".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. H. D. Kay: "Modern Developments in Dairy Science", III. "Problems of Milk Distribution and Manufacture".*

INSTITUTION OF CIVIL ENGINEERS (STRUCTURAL AND BUILDING ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Mr. W. E. J. Budgen: "Modern Computation Methods and Office Practice in the Design of Statically Indeterminate Structures".

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Mr. H. W. Lee and Miss E. A. Neumann: "Surface Treatment of Lenses".

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS' SECTION) at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Sir A. Stanley Angwin: "Recent Progress in Telecommunications due to the use of New Materials".

Wednesday, February 9

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Miss E. Strudwick: "Education To-day and To-morrow", 4: "Secondary Schools for Girls".

ROYAL SANITARY INSTITUTE (at 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Discussion on "Rodent Infestation" (to be opened by Mr. W. McCauley Gracie).

SOCIETY OF CHEMICAL INDUSTRY (NUTRITION PANEL OF THE FOOD GROUP) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. F. A. Robinson: "The Vitamin B_2 Complex—Some Recently Characterised Components".

INSTITUTION OF ELECTRICAL ENGINEERS (TRANSMISSION SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. B. L. Metcalf: "Transmission and Distribution of Electricity to Mines".

Thursday, February 10

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Strategy and Tactics of Crystal Structure Analysis by X-Rays".*

KING'S COLLEGE (in the Department of Electrical Engineering, Strand, London, W.C.2), at 3 p.m.—Mr. W. D. Horsley: "Turbo Generator Practice".*

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Prof. J. D. Cockcroft, F.R.S.: "Cyclotron and Betatron".

INSTITUTION OF ELECTRICAL ENGINEERS (INSTALLATIONS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. H. Barron, Mr. J. N. Dean and Mr. T. R. Scott: "Thermoplastic Cables".

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. E. T. Jones: "Flight Testing Methods".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Dr. A. J. Ewins, F.R.S.: "Progress and Problems of Chemotherapy" (Harrison Memorial Lecture).

Friday, February 11

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. G. Ingle Finch, F.R.S.: "Wear of Surfaces and Lubrication".*

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Annual General Meeting. Discussion on "The Mathematical Needs of the Physicist" (to be opened by Prof. H. Levy).

Saturday, February 12

SHEFFIELD METALLURGICAL ASSOCIATION (at 196 West Street, Sheffield), at 2.30 p.m.—Dr. G. Jessop: "Some Electro-chemical Methods of Analysis".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

AGRICULTURAL ASSISTANT to the Agricultural and Horticultural Organizer—The Clerk to the County Council, Shire Hall, Bedford (February 11).

MASTER to teach mainly MECHANICS in the Junior Technical School of Coventry Technical College—The Director of Education, Education Offices, Coventry (February 11).

GRADUATE TEACHER (full-time, temporary) OF ENGINEERING SUBJECTS—The Principal, Twickenham Technical College, Egerton Road, Twickenham, Middlesex (February 12).

ASSISTANT MASTER (full-time, graduate) qualified to take GENERAL ENGINEERING SUBJECTS in the Junior Technical School and MECHANICAL ENGINEERING SUBJECTS up to Ordinary and Higher National Certificate standard in the College senior part-time courses—The Principal, Southall Technical College, Beaconsfield Road, Southall, Middlesex (February 12).

ASSISTANT LECTURER IN PHYSICS—The Registrar, University College, Nottingham (February 12).

HEAD MASTER—The Clerk to the Governors, Sir Joseph Williamson's Mathematical School, 116 High Street, Rochester (February 12).

DEPUTY BOROUGH ENGINEER AND SURVEYOR—The Town Clerk, Town Hall, Ilford (endorsed 'Deputy Borough Engineer') (February 15).

SPEECH THERAPIST—The Chief Education Officer, County Offices, Chelmsford, Essex (February 15).

GRADUATE TEACHER (temporary) OF SCIENCE OR MATHEMATICS, and a TEACHER (temporary) OF ENGINEERING SUBJECTS—The Principal, Luton Technical College, Park Square, Luton, Beds. (February 15).

BIO-CHEMIST—The Medical Officer of Health, 68 St. Giles' Street, Norwich (February 16).

ASSISTANT LECTURER AND DEMONSTRATOR IN CHEMISTRY—The Registrar, University College, Leicester (February 21).

PRINCIPAL of the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton 1 (February 21).

LABORATORY ASSISTANT IN THE DEPARTMENT OF BOTANY—The Secretary, Bedford College for Women, Springfield, Sidgwick Avenue, Cambridge (February 26).

LECTURER (man or woman) in the DEPARTMENT OF GEOGRAPHY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (March 1).

UNIVERSITY LECTURER IN ANTHROPOLOGY—The Secretary of the Appointments Committee, Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

COLLIERY SURVEYOR for the Nigerian Government Collieries—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Order No. O.S.20).

MINE MANAGER and ASSISTANT MANAGER for an underground Chrome Mine in New Caledonia (South Pacific)—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Order No. O.S.17).

LECTURER IN THE DEPARTMENT OF OCEANOGRAPHY—The Registrar, The University, Liverpool 3.

LECTURER (full-time) OF MATHEMATICS AND SCIENCE at three Boys' Junior Technical Schools—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool 1.

LECTURER (full-time) IN MECHANICAL ENGINEERING to teach to Higher National Certificate standard—The Principal, Wimbledon Technical College, Gladstone Road, London, S.W.19.

MASTER FOR ENGINEERING WORKSHOP PROCESSES AND PRACTICE—The Principal, County Secondary School and Cumberland Technical College, Workington.

GRADUATE ASSISTANT to teach MATHEMATICS AND SCIENCE, a GRADUATE ASSISTANT FOR JUNIOR ENGINEERING SUBJECTS in Technical Day School and ordinary National Certificate Subjects in MECHANICAL ENGINEERING in Technical College, and a GRADUATE ASSISTANT for Subjects up to Higher National Certificate standard in MECHANICAL ENGINEERING and be able to teach ELECTRICAL ENGINEERING up to ordinary National Certificate standard—The Chief Education Officer, Education Offices, West Hartlepool.

PHARMACIST FOR THE GOVERNMENT OF NORTHERN RHODESIA HEALTH DEPARTMENT—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 1252).